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DEPARTMENT OF ECONOMICS, OSAKA UNIVERSITY

TOYONAKA, OSAKA, JAPAN.

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RISE AND FALL OF THE QUANTITY THEORY OF MONEY

SHOZO SOBAJIMA

I

But for J.A. Schumpeter's interpretation in his *History of Economic Analysis* that Wicksell and Keynes remained quantity theorists to the last, I would not have written this paper. But the still more important stimulus to my preparing this paper is as follows. Hand in hand with the spread of so-called "mixed" or "dual" economy attended by the system of "managed currency", the crude Quantity Theory seems to hold the field again and, therefore, I think it may not be out of season to see afresh, what it really means and under what circumstances it can be applied with effect.

II

Rise in prices caused by the debasement of coins was frequently experienced already in the medieval times and, consequently, was made the object of study and brisk discussion. It will suffice here to mention only one name of Nicole Oresme as the outstanding authority on this matter, who had an insight into the truth that there was no economic reason for kings and princes to be the "lords" of currencies circulating in their respective dominions. On this ground and, therefore, not on the purely legal and political grounds, he combated against the prevalent practice of debasing money, maintaining that any gain that accrued from it to kings and princes was more unjust than lending money at interest. He also insisted upon the fact that creditors and holders of money were being defrauded by the debasement, and for this reason disapproved of it. However, the general rise in prices that Jean Bodin witnessed in the sixteenth century had its most important

cause in the increase in the supply of money, that is to say, the influx of the American gold and especially silver into Europe, though it was also due, to some extent, to debasement, as his opponent, Jehan Cheruyt de Malestroict, had argued. (Besides the influx of the American gold and silver, which Bodin took for the most important cause of the price rise in 1568, he mentioned the following secondary causes: monopolies, depredations, expenditures of kings and princes, and debasements). And it was this price revolution caused by the influx of the precious metals of full value, on account of an adequate explanation of which Bodin could establish himself as the first advocate of the Quantity Theory of the Value of Money. Reasoning from the factual observation of the relation between the universal rise in prices and the great increase in the quantity of money having intrinsic value of its own, he arrived at the conclusion that the value of money is determined, not so much by the intrinsic value of its materials (*Stoff-oder Substanzwert*), as by its quantity in circulation. In other words, he recognized the fact that the monetary function of gold and silver did affect their value and was thus a logically distinct source of the exchange value of them.

The core of the Quantity Theory founded by Bodin may be formulated as follows. Logically, the exchange value of money needs not depend on its intrinsic value, but may entirely depend upon its function as medium of circulation and, in consequence, may be determined solely by its quantity in circulation. The value of money, or its purchasing power, should thus vary in inverse proportion to its quantity. This core was, thenceforth, worked up in several points by John Locke who stated with emphasis that money exists by virtue of common "consent". First, he gave attention to the velocity of circulation of money as a distinctive factor which, side by side with the quantity of it, affects the effective demand for goods and services. To put the matter in another way, he may be said to have envisaged the phenomenon of the "idle balances" that remain without influence on the formation of money prices. (It is generally held that Richard Cantillon was the first to approach the velocity of circulation, that is, *vitesse de la circulation*,

by way of so-called "turnover" or "transactions" approach, and to state clearly that an increase in the velocity has the same effect on prices as an increase in the quantity of money. In contrast with him, Locke came at the same phenomenon by way of "cash balance" approach and, in consequence, came to envision the idea of idle balances and thus of the rate of spending. In his view, moreover, the price of money lent, *i. e.*, the rate of interest was to be high or low in accordance with high or low profits expected from the merchants' trade. This implies that he did not regard the supply of money as quite an exogenous variable that was accidentally given to the economic system, but looked at it in relation to the demand for loans and the state of trade. If we attach sufficient importance to this implication, it might become inapposit to take him for a quantity theorist, at least for a crude one). Second, he observed that changes in the supply of commodities were able of themselves to cause their prices to fluctuate, even though there were no changes on the monetary side. The implication of this is that he introduced the concept of the "volume of transactions" or of the coefficient of monetary transactions. With these refinements upon the core of the Quantity Theory, Locke may be said to have succeeded not only in assembling the necessary factors of which the Equation of Exchange could be composed, but also in making possible the more precise interpretations of the Quantity Theory itself.

To Locke money was a "barren thing" as he said, notwithstanding the fact that it was made of gold and silver, and this was, I think, a logical conclusion that is consequent on his way of reasoning as quantity theorist. Similarly, to David Hume, most prominent quantity theorist following him, money, having chiefly a "fictitious value", was not one of the "wheels of commerce", but was merely the "oil" that served to make the movements of the mechanism of commerce more smooth and easy. Therefore, it was thought to be a matter of indifference for each nation in isolation, whether it happened to have plenty of money or not, for in his view the prices of commodities would always and necessarily vary in direct proportion to the given quantity of money, no matter how large or small it might be. Again, any nation having

economic relations with others would have no reason to preserve with care its money within the country. Instead, it might safely trust its money to the natural course of inflows and outflows, for money, *i. e.*, gold and silver would be automatically distributed in proportion to the level of industry and commerce in each country and thereby the price levels of different countries would be kept in line. Here we can see Hume's firm belief in the automatic working of the "price specie-flow mechanism" or the natural establishment of the "triple equilibrium", as it is often so called. (It is one thing that Hume was confident, on the level of pure logic, of the automatic and smooth working of the "price specie-flow mechanism", but it is another thing that he did not put unconditional trust in the practical working of this mechanism. He was well aware of the frictions and disturbances that might attend its working in practice. And this seems quite natural, if we reflect how his "free trade" theory came into existence. His performance in this respect consists mainly in his successful assembling of the useful pieces contained in the Mercantilist balance-of-trade doctrine into a more consistent theory. It was, in a sense, a good corrective of the Mercantilist fallacies and insufficiencies then current. As for his dynamic analysis of the practical effects of a change in the quantity of money upon the economic process, I will speak a word in a moment).

III

Now, one may well call in question how and why it is possible that money, essentially a "barren thing" unable by itself to produce anything of value, does, none the less, yield the fruit of interest. According to Locke, it is made possible by means of the contracts of money loans by which the returns for labor of one person are transferred to another, while these loan contracts themselves originate in "the unequal distribution of money". That he tried to explain the existence of the interest on loans on the ground of the *social* conditions of unequal distribution of money, suggests that he had not yet adequate recognition of the *economic* function of money capital as an independent factor of production and, in consequence, of the existence of capital profit as

a distinctive *economic* category. (His contemporary, Dudley North, is said to have been the first who substituted an economic viewpoint of "stock" for Locke's social point of view of "the unequal distribution" and suggested that the yield from the employment of stock was "profit"). As for Hume, his position differs from that of Locke, in respect that he had full acknowledgement of the positive and economic functions of money as capital, or more exactly, as so-called commercial capital. I have referred above to his mechanical and static formulation of the Quantity Theory, in which money could be nothing but a "veil" spread over the economy. This means that the question of the quantity of money a given country needs has no meaning at all on the level of pure logic. In other words, money would remain quite "neutral" to the economic process. In reality, however, the quantity of money can never be indifferent to its economic functions nor be neutral to the economic process, and Hume himself, as a realist, could not neglect the dynamic effects ensuing on the changes in the quantity of money. His realistic exposition of these effects, in which we can also ascertain his view of the economic function of money as capital, runs as follows: increase in the quantity of money → rise in prices of commodities, neither immediate nor simultaneous, but successive → gradual spread of the opportunities for profitable trades → increase in the trading activities and thence in production → stimulus to industry of every individual, that is, increase in the employment of the idle poor → rise in the price of labor, last of all. (Statements to the effect that the "idle poor" or the "laboring poor" should always be kept as poor as possible, can be amply found in the Mercantilist economic literature. Hume himself, writing in the post-mercantilist times, was of opinion that high wage rates were detrimental to a country's foreign trade, although he was convinced, at the same time, that this disadvantageous effect of high wages on foreign trade did not weigh heavily as compared with the happiness of so many millions of people. Be that as it may, such opinions in favor of low wages, that were to the eyes of most Mercantilist writers synonymous with low labor costs, can be regarded as having been in keeping with social structure of the nationalist States in those times).

One can see in the above summarization of Hume's realistic analysis of economic effects that ensue on the increase in the quantity of money, not only a happy combination of the Mercantilist ideas of the "gospel of high prices" and the "economy of low wages", but also an embryonic form of the monetary theories of business cycles, according to which industrial fluctuations may be caused by, and reduced to, the cyclic expansions and contractions of the supply of money (or, rather, the volume of bank credit). Moreover, one can see in it, if he wishes, a guide to Keynes' doctrine of "effective demand", in so far as both Hume and Keynes put stress upon the dynamic functions that money capital can perform in the economic development. However, we are not to fail to notice the following differences between the two economists.

According to Hume, an increase in the supply of money is sure to raise the price level, but it does not directly and by itself affect the rate of interest, though plenty of money and low interest are concomitant effects of a high state of industry and commerce. The rate of interest is determined, not by the quantity of money, but by productivity and thrift.¹ And, on the other hand, the demand for money is, in his view, elastic only with respect to the prices of labor and commodities. In other words, the demand function for money is thought to be interest-inelastic. Thus it will easily be seen that Hume's position in these respects cannot be compatible with that of most Mercantilist writers and, correspondingly, with that of Keynes who is inclined to join with them. In addition to this difference of opinion, we may well point out the fact that the general economic conditions which Hume met with differ from those with which Keynes was confronted. The former may be characterised by rapid expansion, combined with relatively rich natural resources and undeveloped industry, while the latter,

¹ "Nothing is esteemed a more certain sign of the flourishing condition of any nation than the lowness of interest: and with reason; though I believe the cause is somewhat different from what is commonly apprehended. Lowness of interest is generally ascribed to plenty of money. But money, however plentiful, has no other effect, *if fixed*, than to raise the price of labour.....High interest arises from three circumstances: A great demand for borrowing; little riches to supply that demand; and great profits arising from commerce: And these circumstances are a clear proof of the small advance of commerce and industry, not of the scarcity of gold and silver". (D. Hume, *Political Discourses*, "Of Interest.")

by a very high level of industrialisation and thus of income accompanied by temporary saturation of investment opportunities. And it was under such different economic conditions that Hume could effectively support the Quantity Theory, while Keynes came at last to renounce friendship with it. (As we shall see in a little while, Keynes was too much of an economist, so to speak, to cling to the purely formal logic of Quantity Theory, disregarding the changes in the actual circumstances under which it can find its effective application).

IV

Hume's way of reasoning that productivity and thrift—or in his own words, industry and frugality—determine the rate of interest, came to permeate, through the acknowledgement by the authority of Adam Smith, among the economists in the nineteenth century. It might be called in question, indeed, whether Hume denied any influence whatever of monetary factors on the rate of interest, but here I would not dare to give a decisive solution to this question. At any rate, Smith supported Hume in rejecting the opinion of Locke, John Law, and others that the fall of the rate of interest in Europe was caused by the influx of the American gold and silver. In alliance with Hume he also maintains that the rate of interest on loans on the money market is nothing but a shadow of the rate of profit expected of the real capital, and that on the money market physical capital goods are lent in the external form of money, so that what lenders are supplying in reality is not the money, but the capital goods that the money buys. So long as the money rate of interest were, thus, no more than a mere shadow of the rate of net returns on the capital goods, it would be only too natural that the quantity of money could have no relevant relation not only to the rate of profit but also to the rate of interest. The veil of money, over again!

Now, Knut Wicksell was the first who got clear of these unreal ideas—such as “lending of real capital in the form of money” and “the rate of interest as a shadow of the profit rate”—which had permeated into most of economists under the authorised influence of the

"Classical School". He was the first to make clear that as a matter of fact real capital is not lent, but is bought with the money lent, and that the quantity of money to be lent is determined by the relative price of bank credit, or in other words, by the interest rate in relation to the profit rate (*Zinsspannungstheorie*). His theory is of consequence in the following two respects at the least. On the one hand, relative independence of the money rate of interest as a variable was so adequately pointed out that it cannot any more be regarded as a mere shadow of the net returns on real capital, but can and must have its own influence upon the latter. And, on the other hand, Say's law of market has been impaired at least in its practical value. For the law of market to the effect that supply creates its own demand may hold true with regard to the demand for individual goods and services, but it cannot be so, as Wicksell suggested, when applied to the monetary aggregate demand for the goods and services as a whole.

With the above prefatory remarks we shall now touch on Wicksell's treatment of the Quantity Theory of Money. Being confident of the truth of this theory, or more exactly, the truth of the concept of money implied in it, he attempted to think out its economic logic to the last extremity. In this attempt he put together with success the Ricardian point of view, on the one hand, that banks have unlimited power to increase the medium of circulation by lowering the loan rate of interest, and thus to raise the prices of commodities, and Tooke's view, on the other, that the prices of commodities do not depend upon the quantity of money, but, on the contrary, the amount of circulating medium is a consequence of prices. Put in technical terms, he made a successful attempt of synthesizing the both standpoints of the "currency school" having a near relation with the Quantity Theory and of the "banking school".

Putting emphasis on the fact that increase or decrease in the quantity of money is brought to effect by way of an expansion or contraction of bank credit, *via* the rate of interest on bank loans, Wicksell explained how and why a spread between the "natural" (or "real") rate and the "money" (or "loan") rate of interest gives rise to the

expansion or contraction of the aggregate demand for goods and services and thereby brings about the cumulative changes both in prices and in the structure of production. If the money rate declines below the natural rate, trade and production must be stimulated, and the relations between supply and demand of various goods must be altered. In particular, so long as a relative decline of the money rate raises the present capitalized value of the prospective earnings of new capital goods above their cost of production, it must lead to the expansion of investment in durable capital and thus raise aggregate demand all the more. With this analysis of the economic process as a whole ensuing on a spread between the two interest rates (the so-called Wicksellian cumulative process), he took the decisive lead in transforming the traditional economics of static character into dynamic monetary economics and, as a corollary of this performance, he remodeled the Quantity Theory from which he had started, in its very substance, into an Income Theory worthy of its name. Dichotomy or duality of economics—that is, static analysis of relative prices and distribution under the veil of money, on the one side, and the Quantity Theory of Money as the theory of price level that gives a multiplicative factor, on the other side—has now been renounced in effect.

It goes without saying that, in his analysis of the relative prices of bank credit, quantity of money is no more regarded as an independent variable which is given externally and which can vary independently of prices and of output. Rather, in this analysis, quite contrary to the reasoning of the quantity theorists, necessary supply of money is determined always in relation to the effective demand for it. A physical quantity of money should, now, give place to an amount of *money capital* that is voluntarily determined through the negotiations between bankers and the other entrepreneurs, and its increase or decrease must necessarily affect not only the prices, but also and above all the production and the income. And, side by side with this, mechanical circulations of money as a mere means of payment should retire in the background, while its endogenous behaviors—as capital, income, investment, consumption, and saving—should make their

appearance in the foreground.²

Although Wicksell took the decisive lead in constructing monetary economics of dynamic nature by introducing his analysis of the cumulative process, either upward or downward (that is, the states of "monetary" disequilibrium), his own exposition of income theory, owing to his implicit assumption of "full employment", falls short of true dynamic character. Or, his income analysis is not yet satisfactory for lack of analysis of consumption function and, in consequence, the theory of multiplier. It was J.M. Keynes who introduced the multiplier analysis as the keystone in the study of an economic system as a whole and tried to explain not only the fluctuations of national income but the determination of equilibrium levels of it. We may mention the following circumstances as most important grounds that contributed to his success in actualizing the income theory of Wicksell which he had inherited in his *Treatise on Money*. On the one hand, (1) unemployment on a very large scale has become the ordinary state in mature capitalist economy and (2) the demand of the wealthy for idle balances has come to be more and more elastic with respect to the lower rates of interest. In contrast with the situation in which Wicksell could still rely upon the high interest-elasticity of investment, Keynes laid stress on the possibility that the interest offered by the market on long term securities might be so low that it would cease to attract investors, and at the same time was afraid of the fact that at a certain low level of interest the liquidity preference would become infinitely interest-elastic. On the other hand, we must recollect as theoretical guides for Keynes, (1) that "Marshallian k " can have a quite different economic meaning from that of V in the Equation of Exchange of Fisher's style, notwith-

² As is widely known, Wicksell's concept of the "natural" or "real" rate of interest (*natürlicher Kapitalzins*) is, in his own definitions, not very clear. It has originated in the marginal productivity of Böhm-Bawerk's roundabout process of production and, for this reason, is not necessarily realistic and dynamic. It must have been elaborated by his followers in Sweden, especially G. Myrdal, into the operationally meaningful concept of the marginal productivity of capital or, rather, the marginal efficiency of investment. Much the same may be said with regard to his analysis of the "cumulative process" also. Here, however, I cannot go into details on these matters, though I can suggest, as I hope, some corrections in what I say about Keynes in the following pages.

standing the formal resemblance of them and (2) that in the Mercantilist economic thought the rate of interest is generally derived from the quantity of money, while the demand function for money is interest-elastic. (3) That the investment multiplier of Keynes, the pivot of his macro-analysis of national income and employment, has been derived from R.F. Kahn's employment multiplier, is too obvious to be mentioned. Let us now see how and why he has come to get rid of the Quantity Theory of Money, which he had once accepted and supported.

v

The core of the Keynesian theory of money and prices, or his income theory as a criticism of the Quantity Theory, consists in his laying stress on the demand for money as a means of holding assets, contrary to the latter theory which presumes that any increase in the supply of money will always be spent to purchase goods and services and will never be hoarded as the most liquid form of assets. And his emphasis of the importance of hoarding money as the most liquid asset has its origin, as I have just made mention of it, in the economic implication of k in the Cambridge cash-balance equation that is different from that of V in the mechanical equation of the Quantity Theory. For changes in k that are brought to effect through the voluntary opinions and especially expectations of individual economic units can and do affect income and prices, on the assumption that the total quantity of money is kept constant by the monetary authorities. Keynes had attached importance to this fact when he was, following A. Marshall, still a supporter of the Quantity Theory. But he came, thenceforth, to a decision to reject it, paying now pertinent attention to the fact that the demand for money is elastic, not only with respect to prices of goods but also with respect to the rates of interest. This advancement of his thought might at first sight appear to be an abrupt change, but it is, in a sense, no more than a matter of course. For increase or decrease of income in the Quantity Theory means changes of MV , and increase or decrease in V (that is, income or transaction velocity of money) may naturally be accompanied by a rise or fall of the rate of interest.

Before making clear the position of Keynes against the Quantity Theory, it may not be of no use to give here a summary of what it maintains in the name of Irving Fisher. It assumes: (1) that in any national economy and in a certain period of time, T is a constant that is determined by the given conditions of production and of demand, (2) that changes in M' will normally keep pace with changes in M , and (3) that both V and V' are stable in so far as they are institutionally determined by the system of payment and the usage of people in making use of the currencies. In addition, M is presumed to be an independent variable. On these assumptions it asserts that in the actual economy the price level must rise or fall in direct proportion to the increase or decrease in the quantity of money, P remaining always a passive factor.³

In contrast with the Quantity Theory as summarised above, in which the elasticity of prices with respect to the quantity of money is assumed to be unity, Keynes took into consideration the following chain of circumstances by the medium of which the changes in the quantity of money are connected with the fluctuations of prices. (1) An increase in the quantity of money may lower the rate of interest, on condition that the liquidity-preference function of the public is not raised to the same extent as the money supply increases. But the liquidity-preference function itself does vary with the proportion in which the newly-increased money is apportioned between the industrial circulation and the financial circulation, and this apportionment varies, in its turn, with the extent to which the effective demand increases, and also with the

³ Fisher appears to support the most rigid form of Quantity Theory, in so far as he maintains with emphasis that P is a decidedly passive element in his Equation of Exchange, and that the striking fluctuations in the price level that can be verified statistically are caused in reality, not by the changes of V or changes in T , but only by changes of M . On the other hand, however, he mollifies his above assertion with the following reservations and modifications; that the Quantity Theory holds good only for the situations of equilibrium, but not for the "transition periods" and, therefore, the states of disequilibrium; that V and M may be affected by the fluctuations in T , so that the Theory can not be applied with effect to the long run observations; that behind M , V and T that are the proximate causes of P , there are a number of indirect factors that have influence upon P , *via* these proximate causes. With all these reservations and modifications, Fisher was and remained, after all, a strong and influential supporter of the Quantity Theory, always having firm confidence in its practical usefulness for monetary policy.

proportion in which the increased demand is apportioned between the rise in prices and wages on the one side and the increase in production and employment on the other. (2) The fall in the rate of interest may increase the volume of investment, on condition that marginal efficiency of capital does not decline to the same extent as the rate of interest falls. But the schedule of marginal efficiency of capital itself depends, in part, on the expectations of people as regards the monetary policy in future. (3) Increase in the volume of investment may increase the volume of employment, on condition that propensity to consume does not decline. But the propensity to consume itself and, in consequence, the investment multiplier too, vary with the manner of distribution among different social classes of the new income that accrues from increased effective demand. (4) Increase in the employment and income may have a tendency to raise the prices of commodities, but the extent of the price rise depends, on the one hand, on the forms of physical supply functions of output and, on the other, on the rise in money-wage rates.

It may easily be seen that Keynes' argument restated above takes the following course: quantity of money \rightarrow [rate of interest; marginal efficiency schedule of investment; consumption function] \rightarrow effective demand \rightarrow [cost of production; output] \rightarrow prices; and that the factors put in brackets are ignored in the Quantity Theory under cover of its favorite assumptions, *ceteris paribus*. By the way, it may worth our while to notice that the above arrows do not necessarily imply the merely one-sided causal sequence, for at least in this part of his *General Theory* Keynes has clearly put the relevant factors—such as quantity of money, rate of interest, schedule of marginal efficiency of capital, investment, saving, consumption, output, income, employment, wages, and price level—in mutual interdependence.

In short, in his view a change in the quantity of money can and does have an effect on prices only through the medium of liquidity preference on the one hand and the rate of efficiency rewards (especially wages) and supply functions on the other.

VI

The state of affairs that may derive from the Keynesian theory of

money and prices and that cannot be of little significance in a mature capitalist economy is this: increase in the money supply → fall in the rate of interest → monetization of securities → increase in cash-balance as the most liquid asset → no increase in the effective demand → no rise in income and prices. One might well suspect this situation is no more than a contingency quite remote from the normal conditions, but in doing so he cannot but fall in danger of losing sight of the fundamental and undeniable trend in capitalist economy. For there is no denying the fact that, with large and increasing income, interest-elasticity of investment-demand function tends to be lower and lower, while that of liquidity-preference function tends to be higher and higher. If we now run to an extreme and assume that liquidity function became infinitely interest-elastic, then an increase in the quantity of money would merely result in the hoarding of additional idle balances, without causing any increase in private expenditures. Or, if we put the case that both the investment function and the consumption function became perfectly insensitive to changes in the rate of interest, an increase in the money supply would, here again, not raise the level of private outlays. While admitting that in reality such extreme cases as these would scarcely come into existence, yet they can be of service to do harm not only to the theoretical authority but also to the practical availability of the Quantity Theory.⁴

I think I have no need of speaking any longer against the Quantity Theory, for it has been totally defeated by the Wicksell-Keynesian Income Theory. At the most it might be good to explain the fluctuations of the value of money, only in so far as its unreal assumptions could hold true in reality.

⁴ We should notice in passing that in the above extreme cases the fiscal measures, by which the needed money for transactions purposes are drawn from idle balances, even though entirely unaccompanied by an increase in the quantity of money, will nevertheless be able to increase effective demand, without reducing the private expenditures. And this fact that the effective demand and income can be raised by the fiscal measures that change idle balances into active ones, without being accompanied by any change in the total quantity of money, is likely to become the more important, the higher the level of national income rises. Here one can see an important part assigned to the fiscal policy in advanced capitalist economy (or so-called "dual" or "mixed" economy) and, at the same time, impotence of the Quantity Theory as a guide to monetary policy.

I have mentioned purposely the two names, Wicksell and Keynes, as the representative advocates of Income Theory, in consideration of the fact that these two eminent economists stood, at first, for the Quantity Theory when they started in the study of economics. I think we must attach sufficient importance to this fact, for it can be of service to demonstrate that the Quantity Theory is not a well-founded theory, after all. It is true that in the writings of both Wicksell und Keynes we can find out some traces, indicatory of their giving support to the Quantity Theory. For instance Wicksell stated that an increase in the gold production must have a direct influence on prices, at least to the extent to which it increases the incomes and expenditures of gold producers. He said also, in the preface to his *Geldzins und Güterpreise*, that there really was no theory of money other than the quantity theory and that, if the latter was wrong, we actually have no theory of money at all. As for Keynes, in his analysis of national income, the quantity of money is always assumed to be an independent variable that is given to the system by the action of the monetary authorities. Besides, his own theory of money and prices that we have seen above, may easily be wrought up into a "generalized" Quantity Theory as he himself suggested. However, with all these traces in favor of the Quantity Theory, both of them have eventually renounced it. To judge to the contrary is, I think, to look at the surface only, and to overlook their meaningful efforts and achievements in converting the mechanical Quantity Theory into comprehensive Income Theory.

VII

Some economists insist that, although the Quantity Theory itself cannot be valid as an economic doctrine worthy of the name, the Equation of Exchange underlying it— $MV + M'V' = PT$ —must be accepted, none the less, as an undeniable economic truth. They say that the Equation is true as gospel, in so far as it merely describes the formal and functional relations between the aggregates included in it. I would like to give a comment on this way of thinking, before making an end of this treatise.

In one sense, that is, from purely technical point of view, that may be true. However, if we were to take into account not only M and M' (*i.e.*, banknote and deposit-currency) but whatever that functions as money, the Equation cannot but prove invalid, owing to the limited recognition of the sorts of moneys and near-moneys. Its practical and, especially, statistical availability may thus be said to rest upon its theoretical insufficiency. One must here call to remembrance that "money is that money does".

Moreover, if we once try to take account, without exception, of whatever that functions as money in economic sense, instead of picking out some particular sorts of it (especially legal tender), we are naturally inclined to have an insight into the economic *raison d'être* of money and the *economic* source from which it originates in capitalist economy, or rather, free-enterprise system. We may then be tempted to supplement or, rather, replace the formal relations stated by the Equation with a causal connotation to the effect that PT should be both the cause and the criterion of MV and $M'V'$, in accordance with the "banking principle." For unless the value of goods and services that are to be purchased with money were not given beforehand,—of course, logically beforehand,—there is no determining, from the economic viewpoint, of the needed or adequate quantity of money.

Here we are at the threshold of the most important and most difficult problem in the *economic* theory of money, though it might not come into question for the so-called economic analysts, *i.e.*, technicians without economic sense.

CURRENCY IN JAPANESE FEUDAL SOCIETY

YOTARO SAKUDO

I. PREFACE

The economic system of Japanese society in the early modern times was founded on a feudal economic organization. As time passed, however, a contradiction between natural economy and money economy came to appear above the surface.¹ This general tendency may be characterized by two aspects—development from local economy to nation-wide economy or national economy and transition from natural economy to money economy.² What manifested these fundamental trends were the movement of extending the economic sphere throughout the country, centring about early modern cities under the immediate control of the Shogunate, such as Edo, Osaka, etc., and briskness of economic activities rising from castle-towns under the rule of feudal lords.³ Through the above historical process it became year after year more difficult for the feudal lords to keep up the policy of decentralized economy; territory economy or local economy confined in a territory of each feudal lord was at length brought to a deadlock, and it was forced to give way to the current of the times, conversion into big-scaled nation-wide economy.

¹ The period of 265 years from the 8th year of Keicho (1603), when Ieyasu Tokugawa acceded to the Shogunate, to the 3rd year of Keio (1867), when the Tokugawa Feudal Government collapsed, restoring the governing power to the Emperor and opening the way for the Meiji Restoration, may be regarded as the early modern times of Japan. If this be approved, the period of currency history in the early modern times, which is our present theme, will roughly correspond with the above period.

² The general trends of the economic organizations of Japanese society in the early modern times are described in detail in and after page 106 of *The System of Japanese Commission Business in the Early Modern Times*, 1951, by Mataji Miyamoto.

³ As to the study of the economic situations of Osaka which was the greatest centre of commercial economy of the day, we find Mataji Miyamoto, "Economic and Social Development of Osaka" in *Osaka Economic Papers*, Vol. III, No. I, Dec. 1954. Shigetomo Koda, *Edo and Osaka* (revised and enlarged edition), 1942., also presents a positive study of Edo and Osaka from the standpoint of economic history.

It may be said that what stipulated such a current of times most strongly were the universal currency of commodities caused by ware production in those days and, consequently, the developing tendency of money economy. It was not until the footing of this developed money economy had been established that there appeared the tendency toward the formation of nation-wide economy.

Now, as to the developing process of Japanese money economy forming her economic history, let us firstly describe, taking account of the general trends stated above, the incentive to the issue of paper-currency, in order to trace its circulation which was the most developed form of currency economy (par. II), secondly look into the problem of its methods and systems (par. III-IV), thirdly discuss in detail the circulating force of the paper-money, viewing the subject from three angles—the sphere of circulation, the basis of circulating force and the state of circulation (par. V), and lastly inquire into the measures taken to promote the circulation of the paper-money (par. VI).

The issue of paper-currency as was carried out by the feudal lords is one of the economic phenomena characteristic of Japan in the early modern times, and it may be worthy of being watched closely. Moreover, it is what cannot be easily found in the European economic history, and is surmised to be somewhat peculiar to Japan.⁴

⁴ As to the paper-currency in the early modern times, several articles of mine have been made public up to date, and the data of localities for them are picked up from the following: a) For Kinki District: "A Study of the Money Circulation in Rural Communities in Tokugawa Period" in *The Historical Analysis of the Organizations of Rural Communities*, 1955, by Mataji Miyamoto, "Growth and Basis of the Paper-Currency in Tokugawa Period" in *The Development of Commercialized Agriculture*, 1955, by Mataji Miyamoto. b) For Chubu District: "On the Expansion of the Circulation of Money in the Closing Days of Tokugawa Period", *The Economic Review of Osaka University*, Vol. IV, No. IV, 1955. c) For Kyushu District: "Substance of the Paper-Currency in the Early Modern Times, *The Economic Review of Osaka University*, Vol. II, No. I, 1952. "The History of the Issue of Paper-Money at the Kurume Clan", *Journal of Political Economy*, Vol. XVII, No. II, 1951, Economic Society of Kyushu University. d) For Shikoku District: "The Aspects of the Circulation of Paper-Currency", *Matsuyama University of Commerce Review*, Vol. 1, No. IV, 1950. e) In addition to the above, a general historical study was dealt with in my article "The Development of Money Economy in the Early Modern Times", 1952.

All of these mentioned above are studies of special sorts, but they are thought to furnish the materials for conjecturing the whole affairs to some extent and making a general study.

II. CAUSES

Generally speaking, the direct causes of the issue of paper-money in the fiefs of the feudal lords in the early modern times may be attributed to the following facts:

1. There was too great a shortage of metallic currency or minted coins put in circulation in the fiefs of feudal lords to meet the public demand.⁵

2. The clans vied with one another in the issue of local paper-money, and any clan rejecting the policy was in danger of getting its metallic currency absorbed by the neighbouring clans. Thus the issue of paper-money was an inevitable counter-measure for every clan.

3. In order to relieve the financial straits of feudal lords paper-money would patch up finances held sway.⁶

In case where one or more than one of the above factors came in existence, note-issuing by the clans became matter-of-course.

This tendency was seen in almost every clan throughout the country, and the currency policy by the feudal lords came to develop into the shape of paper-money policy. Such a trend of the times was not confined in the fiefs of the feudal lords, but spread to the territory controlled direct by the Shogunate, the domains belonging to direct feudatories of the Shogunate, the fiefs of temples and shrines, etc. This was quite

⁵ Generally speaking, in the Genroku Era (1688-1703) the output of materials for mintage, viz. gold, silver and copper, was on the decrease throughout the country, compared with that in the Keicho Era (1596-1614), which caused monetary stringency in the financial circles of those days. Hand in hand with these situations there came out a gradual increase in the circulation of paper-currency from the Genroku Era onwards. In case of European countries, however, circumstances appear to have been utterly reverse. For instance, the case of a surplus of gold and silver as was seen in the European market in the period 1493-1600 is unparalleled in the financial history of Japan. What was more, it is thought that in Europe this state of of the financial circles influenced the periods following. The fundamental difference and the reverse state of affairs of this sort should be a subject of comparative study. It is added here that the substance of the inflow of gold and silver into Europe during the period 1493-1600 is comprehended by the perusal of the following: E. J. Hamilton, *American Treasure and the Price Revolution in Spain, 1501-1650*, 1934, Chap. II., *Imports of American Gold and Silver*, pp. 11-45; John U. Nef, *Silver Production in Central Europe, 1450-1618*, *Journal of Political Economy*, Vol. XLIX/4, 1941, pp. 575-591.

⁶ Iwao Kokusho, *Control and Strife in Japanese Feudal Society*, p. 63; Suisuke Komiyama, "Currency in the Modern Age", *The Review of the History of Japan*, 1903, p. 530.

the contrary to the fact that the currency policy taken by the Tokugawa Government was promoted with the three kinds of metallic currency—gold, silver and copper, as its core, and that minted coins were the chief object of the policy. The Tokugawa Government, which had stuck to the policy not to issue paper-currency, came to give up its long-cherished policy. In the 3rd year of Keio, 1867 A. D., at last, in order to raise funds for supporting the foreign trade at Yokohama in the Kanto district the Shogunate issued paper-money available for the limited areas of Edo and Yokohama, which later came to be circulated in Edo and throughout the eight provinces of the Kanto district. In the Kansai district, too, the Bakufu or the Shogunate gave an impetus to the establishment of a company for the opening of the port of Hyogo, issuing the Bakufu paper-money to be circulated in the Kinki district only.⁷ No other sorts of paper-money than those mentioned above were issued by the Bakufu itself, which means that the paper-money issued in the 3rd year of Keio was all that was issued by the Bakufu. This, it might be stated, was due to the fact that the Bakufu could not promote the growth of its economic basis so as to put its paper-money in country-wide circulation, and accordingly that the Bakufu failed to win the people's credit to get the paper-money circulated in place of metallic currency. These circumstances caused each of the clans to take advantage of the financial impotence of the Tokugawa Government and develop its own paper-currency system by means of some feudalistic methods and organizations peculiar to the locality.⁸

⁷ As to the issue of the Bakufu paper-money, refer to Eijiro Honjo, *New Policy at the Closing Days of Tokugawa Period*, 3rd revised edition, 1940, pp. 91-99, 266-289.

⁸ In conducting researches in the issue of paper-money in the early modern times of Japan, as stated above, attention has been focused on its direct causes. But consideration ought to be given also to the most fundamental matter which made possible the issue and circulation of the paper-money. It depended on the capacity for paper-money economy in the areas of castle-towns under a feudal lord's reign and their neighbouring rural communities whether the economic policy would prove successful or not. Especially, in this case the most fundamental thing was that the economic policy rested upon the growth of the social organizations of the rural communities of Japan in the early modern times, viz., upon the degree and extent it was developed. From this point of view, it was the growth of money economy in the rural communities that determined the success or failure of paper-money policy in the fiefs of feudal lords.

III METHODS⁹

The issue of paper-money by the clans required permission of the Bakufu; it was not permitted for any clan authorities to issue their paper-money solely upon their own responsibility. The clan government, therefore, applied in principle to the Bakufu for permission every time paper-money was to be issued.¹⁰ In order to carry out its monetary policy, the Bakufu, making the most of this privilege, took action to prohibit on a nation-wide scale the issue and circulation of paper-currency in the fiefs of the feudal lords: in the 4th year of Hoei (1707) the Bakufu issued a proclamation checking the issue and circulation of paper-money by the clans throughout the country, on the plea of the disorder that some clans had their paper-money in circulation and others had not, which would on the whole bring about undesirable situations in the circulation of currency.¹¹ Gradually intensifying the control of the issue of paper-money, in the 15th year of Kyoho (1730) the Bakufu

⁹ In most cases clan governments carried into effect the issue and circulation of paper-currency, putting it under a monopoly system conducted by themselves. This monopoly system was a sort of manufacture operated by clan governments in combination with commercial funds, local or central; it was a privilege manufacture. The mutual relations between such a clan-operated monopoly system and paper-money issuing are described in full in *The Monopoly System in the Early Modern Times of Japan* by Yasuzo Horie, 1933. A study of mine on the relations between clan-operated monopoly system with paper and wax and the paper-currency circulated in the areas has been made public in the following articles: "A Study of the Monopoly Systems in the Early Modern Times" in *The Articles on the Economic History of Kyushu* by Mataji Miyamoto, 1954; "The Management of the Raw Wax Administration Bureau in the Tashiro Fief of the Tsushima Clan", *The Economic Review of Osaka University* Vol. I, No. II, 1952; "The History of the Paper-Money Issuing in the Uwajima Clan", *Matsuyama University of Commerce Review*, Vol. I, No. I, 1950.

¹⁰ It seems difficult to judge of the whole immediately by this principle. In the district of Kyushu, for example, paper-money was issued without permission of the Bakufu in most cases according to Yorei Miyoshi, a scholar living in the district at the close of the Tokugawa régime. In this connection, an opinion of mine was stated in the article "A Passage on the Thought History of Paper Currency in the Early Modern Times," *The Economic Review of Osaka University*, Vol. IV, No. III, 1954.

¹¹ The full text of this ordinance of prohibition proclaimed by the Tokugawa government is mentioned in the following works: *A Study of the Tokugawa Prohibition Ordinances*, Vol. VI, 1932, p. 273; *The Collection of Historical Events—Currency Dept.*, 1932, p. 430. It seems that what was intended by the Bakufu's prohibition order issued in the 4th year of Hoei was probably to promote the circulation of the three sorts of coins reminted by the Bakufu during the Genroku Era, the inactive circulation of which was a cause of worries to the Bakufu authorities.

strictly prohibited a new issue of paper-money, and also put various new restrictions on the clans which had their paper-currency circulated already. It was one of the main points that the authorized term for the circulation of paper-money should be 25 years for feudal lords with an annual income of 200,000 koku of rice, and 15 years for smaller ones. It was furthermore provided that in case when the continuative issue of paper-money was needed at the expiration of the authorized term a report to the effect should be made to the magistrate of finance of the Bakufu. The above restrictions were in effect as a fundamental regulation up to the Meiji Restoration.

As stated above, externally clan authorities were required to obtain permission of the Bakufu, while internally they had to strive by all means to put their paper-currency in general circulation. These circumstances obliged clan governments, holders of local authority, to take up a legal step for endowing their paper-money with circulating force maintained by 'national compulsion' or 'compulsory currency'.¹³ However, the political and legal step described above was not the only support. It was rather due to the credit of influential rich merchants under the rule of a clan that in many cases paper-money was put in circulation throughout considerably wide spheres, gaining currency with the world.¹⁴ In short there were thus two sorts of aspects—legal and economic. Moreover, in order to maintain the nominal value of notes put into circulation and win credit with their users, it was necessary to take the following measures: (1) Checking the excess of circulation of paper-currency over the proper amount—preventing an overissue of notes, (2) Providing reserve funds for repayment by the establishment of conversion systems. This very problem of conversion systems is a matter of great importance to the issue and circulation of paper-money; it is worthy of special notice. This problem will be discussed in the following chapter (organization).

¹² *The Historical Materials of Finance and Economics of Japan*, compiled by the Ministry of Finance, 1924, Vol. II, p. 846.

¹³ For instance, refer to *The History of Koriyama-cho*, 1953, pp. 442-445, 458-459.

¹⁴ As an instance, I introduced the case of the Nakatsuji family in the Kinki district. "Methods and Funds for the Issue of Paper-Currency for Rice-Marketing," *The Economic Review of Osaka University*, Vol. III, No. I, 1953.

IV ORGANIZATIONS

In case when paper-money was issued in a feudal lord's fief, what was called 'Magistrate of Currency' was posted as an official of the highest rank for the operation of paper-money, and the 'Paper Currency Administration Bureau', as it was called, was established for the purpose of supervising and managing the conversion of metallic and paper-currency and accounting business. Along with these officials constituted on the side of a clan government, the so-called 'Paper Currency Promoters' stood for the people under its rule, and they were closely connected with the Paper-Currency Administration Bureau, an organization subject to them. The paper currency promoters, who were most essential to note-issuing, were proficient in arithmetic, shrewd in ascertaining fluctuations in financial circles, and quick in foreseeing and penetrating social situations. The organization for the issue of paper-money thus necessitated the union of power of the two sorts—that of clan government officials representing public power and that of common people, chiefly merchants, on behalf of private power. The lack of either of the two made note-issuing impossible.¹⁵ However, the business executed by clan-government officials tended to pass into the hands of common people. In addition to that, there were pretty many cases in which even at the outset there appeared slovenly control by clan governments and great authorized power of common people's mighty organizations.¹⁶

In order to promote the circulation of paper-money, it was absolutely necessary that its economic basis should be accompanied by conversion system as security.¹⁷ It was for this reason that clan governments

¹⁵ With regard to the organizations for the issue of paper-currency, a certain case was dealt with in my article previously mentioned—"The History of the Issue of Paper-Money at the Kurume Clan", *Journal of Political Economy*, Vol. XVII, No. II, 1951, Economic Society of Kyushu University, op. cit. The state of affairs hereby described will suffice to let us analogize fairly universal cases.

¹⁶ In this connection, an instance was cited in my article "A Study of the Money Circulation in Rural Communities in Tokugawa Period" in *The Historical Analysis of the Organizations of Rural Communities* by Mataji Miyamoto, 1955, op. cit.

¹⁷ As a premise of conversion systems, the circulation outside a fief must be given consideration along with that within the area. Above all it should be under consideration that in the former case metallic currency was issued for settling accounts between clans.

called upon influential merchants to act as paper-currency promoters and that they exerted themselves to map out plans for providing reserve funds and carry them into effect. As to rates of reserve, they were varied, showing considerable disparity between the highest and the lowest as seen in the cases mentioned below. At the start of the issue of paper-money over 100 per cent reserve funds used to be provided, but there was a gradual falling-off of the amount reserved. In some cases about 55 per cent funds were in constant reserve for conversion,¹⁸ and in others some 13 per cent reserve funds could manage to get along.¹⁹ Besides there were some cases in which at least 15 per cent funds were reserved for occasional conversion.²⁰ In spite of the differences in ways, all the above cases were successful in promoting conversion system. There occurred no tragic incidents of the so-called 'Paper-currency riots' or 'Currency nullification'. Accordingly, success or failure of conversion system did not depend so much on the sum of reserve funds as on opportune measures taken by the paper-currency promoters, especially on the ability to divert outsiders' funds to official ones according to circumstances.²¹ The arrangement of conversion system alone let paper-money be in wide circulation, maintaining its characteristic feature as convertible paper-currency and its function.

V CIRCULATION²²

In discussing the circulation of paper-currency instituted in a feudal lord's fief in the early modern times, let us first describe the circulation sphere of the paper-currency, next mention what its circulation was

¹⁸ For instances for this case, refer to my article "The Substance of the Paper-Currency in the Early Modern Times", *The Economic Review of Osaka University*, Vol. II, No. I, 1952, op. cit.

¹⁹ This point was touched in my article "Method and Funds for the Issue of Paper-Currency for Rice-Marketing", *The Economic Review of Osaka University*, Vol. III, No. I, 1953, op. cit.

²⁰ Regarding this case, vide my article "On the Expansion of the Circulation of Money at the Closing Days of Tokugawa Period", *The Economic Review of Osaka University*, Vol. IV, No. IV, 1955, op. cit.

²¹ This problem was illustrated with practical data quoted from history in my article "A Study of the Money Circulation in Rural Communities in Tokugawa Period" 1955, op. cit.

based on, and further inquire into the general tendency of the circulation status.

1. Sphere of Circulation

It was a general rule that the sphere of the circulation of the paper-money of a clan should be limited within the territory, but the circulation of commodities in those days was not confined within the border of a clan fief; it spread outside the border. The paper-money circumscribed in currency area came to show a similar trend, too. The free circulation of the paper-money became active in proportion to the prosperity of commodity circulation which spread to a nation-wide extensiveness, and the credit to the currency gradually increased at the same time until it came to show its character as the credit currency of the early modern times. From this point of view this phenomenon is worthy of notice. Therefore, if the paper-money of the day had been issued for the mere purpose of relieving the financial straits of clan governments and could have been in circulation only with the good backing of the political power or national compulsion of clan governments which were holders of local authority, even its circulation within each fief would have been carried out on a very small scale, and for a short period, too, to say nothing of its free circulation. From this point of view we are required to be watchful of the expanding trend of circulation sphere.

²² It is extremely difficult because of the limited historical data to decide the amount of paper-money in circulation in the early modern times. It is possible, however, to ascertain that for a particular period and for some limited area. (e. g. "The Substance of the Paper-Currency in the Early Modern Times", 1952, and "Methods and Funds for the Issue of Paper-Currency for Rice-Marketing", 1953, previously mentioned) As to the general standard of the circulation amount, it is thought that 10,000 ryo of paper-money was a moderate amount of circulation for the fief of a clan receiving an annual income of 10,000 koku of rice. This idea was inherited until the early period of the modern age, and the first governmental paper-money, 'Dajokan Currency'—paper-money convertible to gold coins issued by the Administrative Council of the Restored Imperial Government in the 1st year of Meiji, was advanced on loan to local authorities all over the country, at the ratio of 10,000 ryo of money per 10,000 koku of rice as an annual income, as was called '10,000-koku loan'. This point was discussed in detail in one of my articles "A Study of the Currency System Reform in the Early Years of Meiji", *The Economic Review of Osaka University*, Vol. IV, No. I & II, 1954. Furthermore, with reference to the sum or amount of paper-currency in the early years of the modern age (the 2nd and the 4th years of Meiji), there are historical materials based on its nation-wide investigation. Vide: *A Collection of Historical Materials of Finance and Economics in the First Term of the Meiji Era*, Vol. XIII, 1931, pp. 24-37.

2. The Foundation of Circulation

This may be observed from two angles. The one to be mentioned is legal measures, compulsory circulation, and the other to be pointed out is the establishment of conversion systems, provision of reserve funds as an economic foundation to support the legal compulsion. This problem has been discussed in the preceding paragraph (organization). Owing to these supports, the paper-money could maintain the function as convertible notes, fulfilling its mission as the currency of the day and avoiding to turn inconvertible.

3. The State of Circulation

The paper-currency of the day was used first for public affairs such as tributes, taxes and donations, and next also for private concerns such as common business and loans. Thus it was used in the former cases of up-and-down or vertical connection, and in the latter cases of lateral or horizontal connection as well. It had two sections—one-sided relations and mutual or bilateral ones. Generally speaking, moreover, the use of the paper-money tended to shift from the public to the private.²³ In considerably many cases the circulation of the paper-money spread over castle-towns (urban communities) as its centre, and then extended to adjoining villages (rural communities). But all the cases cannot be concluded to be the same; there were some cases in which rural communities were the object of circulation from the outset.²⁴ After all it may be stated that supported by the highly and widely developed organizations of rural communities in the Tokugawa Period the circulation of paper-currency gradually became active.

VI MEASURES

Each clan government put in practice compulsory circulation of its paper-money based on its own political authority in order to secure the

²³ This subject was described through some practical historical materials in the article previously mentioned "The Aspects of the Circulation of Paper-Money", *Matsuyama University of Commerce Review*, Vol. I, No. IV, 1950, op. cit.

²⁴ In this connection, refer to my article "A Study of the Money Circulation in Rural Communities in Tokugawa Period", 1955, op. cit.

circulating force of paper-money and put it in smooth circulation among the general public, and at the same time took various measures to maintain its credit, preventing an overissue of paper-money to avoid an abnormal fall of its value. Now, regarding the measures taken by the authorities concerned to maintain the circulating force of their paper-money, let us make a study of them from two points of views, roughly classifying them into two sorts, positive measures and negative ones.²⁵

1. Positive Measures

The following were the most general:

a) First of all the issue of new notes may be mentioned. This resulted chiefly from the clan authorities' intention of renovating popular feeling in the area and confirming again their own responsibility through the attempt. This step had quite a temporary effect to maintain circulating force. b) Secondly we might point out the delivery of 'stamped paper-currency' (paper-currency with new official stamps to guarantee its convertibility) in exchange for old paper-currency in circulation. In those days when printing was quite imperfect in its primitive stage it was no easy task to issue new paper-money, this anomalous step was taken with intent to renovate popular sentiment and confirm again the responsibility charged on a clan government. Besides these, various measures, such as c) the mintage of copper coins, d) the joint use of paper-currency and silver coins, e) the issue of rice-notes and f) the raising of reserve funds for conversion, were also helpful to some extent to achieve the purpose.

2. Negative Measures

The following four measures may be mentioned as the main ones:

a) The compulsory withdrawal of paper-currency, b) The burning-up of the paper-money withdrawn, c) Reforms in the organizations for the circulation of paper-money, d) The promulgation of an ordinance

²⁵ In regard to these two counter-measures, a study based on original historical materials was introduced in my article "The History of Paper-Money at the Kurume Clan", 1951, op. cit.

stimulating frugality. However, these measures had only quite indirect and negative significance; they cannot be thought to have ever served to give instant results to the improvement of the situation. Therefore, in order to maintain the nominal value of paper-currency and secure its circulating force, great care had to be exercised to complete two conditions by any means—the prevention of an overissue of notes²⁶ and the completion of conversion systems.²⁷

VII SUMMARY

On the whole, as the fundamental line of the historical development in the feudalized society of Japan in the early modern times transition from natural economy to money economy side by side with development from local to nation-wide economy can be indicated. Focusing our attention on this general situation, we have made some study of the circulation of currency which formed such a fundamental line, especially limiting the scope of description to the circulation of paper-currency. The essential points are summarized in conclusion.

1. It is generally thought that the issue of paper-currency by the hands of feudal lords resulted chiefly from a shortage of the proper

²⁶ The counter-measures taken by clan governments for the maintenance of the circulating force of their paper-money were closely related to the problem of results brought about by the issue and circulation of the paper-money, viz. the degree of success in these counter-measures could be measured by advantages and disadvantages (or merits and demerits) brought to the clan governments themselves and the people under their rule. The problem of such results or effects, observed from both standpoints—clan governments and common people, was treated in my article "The History of the Issue of Paper-Money at the Kurume Clan", 1951, op. cit.

²⁷ In connection with the above subject, Ekken Kaibara (1630-1714), who was a Japanese savant in the early modern times, advocated that the secret of successful operation of paper-money was to issue it little by little and that by doing so paper-money would become handy together with metal currency. To the similar opinions of several scholars, such as Chikuzan Nakai, Banto Yamagata, Yorei Miyoshi, etc. who affirmed note-issuing and discoursed on effective ways to carry it out, others insisted on their opposite views. Among the latter were some great scholars, such as Naokata Kusama, Keisai Asami, Hakuseki Arai, Koki Shoji, Shinen Sato, Shundai Dazai, etc., all of whom differed with the former about the development of monetary economics of the day. This subject was dealt with in my article "A Passage on the Thought History of Paper-Currency in the Early Modern Times", 1954, op. cit.

²⁸ I went rather into details of the problem of conversion system in the article "The Growth and Basis of Paper Currency in Tokugawa Period" in *The Development of Commercialized Agriculture*, 1955, by Mataji Miyamoto.

amount of currency in circulation, the effect of the note-issuing by neighbouring feudal lords, and the counter-measures taken by feudal lords to relieve their financial straits. The foundation of this economic phenomenon, the issue of paper-currency, was in many cases fixed and supported by the developed organizations of cities and their adjoining rural communities in the early modern times, especially by the developed money economy in rural communities. (Par. II Causes)

2. In issuing paper-currency, each clan government was required, on one hand, to obtain permission of the Shogunate, and on the other it exerted itself to take a legal step for the compulsory circulation of its paper-currency and establish a conversion system as its financial basis. (Par. III Methods)

3. The formation of the systems for the issue and circulation of paper-currency necessitated the combination of two powers—officials of a clan government and representatives of common people (chiefly merchants). In order to make a good use of the systems, the appointment of ‘currency promoters’ was especially important, whose wealth and credit used to support and promote the circulation of paper-currency. (Par. IV Organizations)

4. The sphere of circulation of any paper-money (the area where the paper-money was available) was limited to one fief; the fief under the direct rule of a feudal lord was the area of currency. But this rigid limitation being gradually loosened, there came to appear a developing tendency toward outward circulation. Such circulating force was grounded especially on the compulsory circulation of paper-currency and the retention of reserve funds for conversion. The latter of the two, viz. the completion of conversion systems, was a factor to prevent paper-money from becoming inconvertible and enable it to display its full function as convertible paper-currency. Thus the paper-money of the day was used both for public affairs (vertical connection), such as tributes and taxes, and for private concerns (horizontal connection) as were seen in common business, having a large circle of circulation and many lines of activity. (Par. V Circulation)

5. For the maintenance of the circulating force of their paper-currency

clan governments took positive measures (or direct steps), as were seen in the issue of new paper-money and the delivery of paper-money stamped to guarantee its convertibility, and pursued negative measures (or indirect steps) such as the compulsory withdrawal of old notes and the burning-up of them. After all, there were fundamentally nothing more than measures for preventing an overissue of paper-money and completing conversion systems. (Par. VI Measures)

The paper-money issued and put in circulation by feudal lords continued to exist till the early stages of the modern capitalistic society, and it had to pass through the revolution of the Meiji Era before the paper-money of the modern age took its place. It was in June in the 12th year of Meiji (1879) that the paper-money as the local currency characteristic of feudalism gave way to the modern currency unified throughout the country.²⁹

It is added here, to express gratitude, that in writing this article I owed much to the co-operation of Mr. Toshikazu Satomi, my esteemed friend, and Mr. Akitaka Omine.

²⁹ The above subject was discussed rather minutely in the following articles of mine: "The Introduction of Foreign Capital and the Development of Currency Systems" in *The Accumulation of Capital and Employment*, 1953, by Yasuma Takata. "A Study of the Currency System Reforms in the Early Years of Meiji", 1954, op. cit.

THE SOCIAL POWER OF TRADE UNION

Yoichi UTSUMI

1. Collective bargaining power and monopoly of labor supply

A trade union is an economic organization with the primary aim to improve working conditions, particularly the wage rate, by means of collective bargaining. The fact that the trade union is in favorable position for securing better working conditions than those obtained according to the individual labor contract, is best explained by the power of collective bargaining possessed by the former. The collective bargaining power, or the union bargaining power, is after all a power with which the trade union accomplishes its objective through employer-employee bargaining.

Then, where is such power originated from? What kind of function serves a trade union to win conditions better than those through individual labor contract? The most conventional answer to these questions would be to define that the intrinsic nature of the trade union is the monopoly of labor supply. Such definition must have been developed in the western tradition of individual freedom that often prohibited trade union activities or restricted them by laws such as Sherman Act, based on the same philosophy as that applied to the protection of free enterprise system.

Then, in what sense a trade union monopolizes the labor supply? The word "Monopoly" has its origin in a certain Greek which means "single sale" (Allein-Verkauf). In the present-day economics "monopoly" is understood as control of supply (or demand) by a single party and the "control of supply", in turn, means to determine the price either indirectly by changing the supply or directly by taking the demand into consideration. Whereas in free competition suppliers have, more or less, to accept a given market price, monopolistic suppliers try to determine the price of their own accord taking market reaction into account. Of course, there must be scarcely the case of

perfect monopoly in the actual market and the patterns in existence are the mixtures in between the perfect monopoly and perfect competition.

The trade union is empowered by its member workers with the right to decide the terms relating to the supply of their labor and, to that extent, the union is able to control individual workers. Japanese laws also stipulate that the collective agreement shall have priority to the individual labor contract. Accordingly, competitions among individual workers give way to the trade union who acts as a single and only representative of workers for the dealing of their wage rate. In this case, the possibility of having competition from outsiders is eliminated in two ways. The one is the difficulty often witnessed in the case of craft union when the outsiders are hard to acquire sufficient skills and the difficulty that comes from the immobility of workers particularly in the intrafirm unions or industrial unions. The greater the size of union is, the harder for the employers to get alternative labor from outside. Also influential is the trade cycle and there is less opportunity to face competition from outsiders when there is less unemployment. The other is the defensive measures taken by the trade union itself: the systems of closed shop, union shop, picketing etc.

It is therefore clear that the union monopolizes the labor supply to the labor market formed between its member workers and an employer or a federation of employers. Furthermore, the trade union has implicitly more or less monopsonistic power against those who deal the products of the employer. It can be considered that the so called "consumption boycott" is carried out by making use of such monopsonistic position.

As referred to above, monopoly of supply is generally made through price determination either directly or by controlling supply. Almost same function is witnessed in the activities of trade unions as monopolizer of labor supply. The process of winning or retaining high wage rate by trade unions pursues three different steps. The one is to restrict labor supply according to the legislation of maximum working hour or either by charging high initiation due, demanding a long apprenticeship period, or by refusing new members and alternative work by non-union members, or by restricting job burden etc. The second

one is to directly raise the standard wage rate, the core of a collective bargaining. As the third, there is an uplift of the "derived demand curve" as referred to by Paul A. Samuelson in his text book¹ but this should be considered as a co-operation with enterprises by trade unionists rather than as a proper function of trade union. Such monopolistic power of trade unions varies from one to another depending, on one hand, upon to what extent collective agreement provides for protecting the union members from the possible competitors as well as other tactics of the union, and, on the other hand, largely upon the size of the trade union. Regarding the former, the question is what kind of "shop" it is. The monopoly power is weakest in open shop, followed by union shop while closed shop is the strongest. Though Taft-Hartly Act recently banned closed shop, the fact still remains that monopoly power is generally on the increasing trend. Further, the picketing is playing an important role in the elimination of competitors. Supposing the above conditions are held equal, it is clear that the monopoly power varies with the size of trade union. Because of this, each intrafirm union is inclined to form industry-wide union and, further, a larger federation converging many different industries.

Above is the prerequisite recognition necessary to analyse trade union activities in accordance with monopoly theory. Many economists, especially those of U. S., have accomplished successful work based on this monopoly theory which is certainly a valuable reference to our study. However, there still remains a skepticism if there is too wide a gap between such theoretical model and the realities, or, at least, if the monopoly theory could not be so reasonably applied to trade unions just as it is to monopolistic enterprises.

2. The bilateral monopoly of labor

The first ground that the monopoly theory is unable to serve or of little use to the analysis of the function of the trade union is that even should the trade union activities monopolize the labor supply such monopoly could not display itself in the labor market where employers

¹ Paul A. Samuelson, *Economics*, 1951, pp. 598-599.

are competing with each other for labor. Namely, the major conditions which enable the monopoly of labor supply will, immediately and yet in more strengthened form, serve to create monopsony of labor. The immobility of laborers including difficulty of switching their skill from one to the other, tenacity for job, difficulties of changing their living place, is also a great problem here. Furthermore, workers are supposed to know less about the labor market than employers, and there is always unemployment though its number changes from time to time. Besides, when the union puts restriction on employing qualification (i. e. closed shop system) the chance of getting job for outsiders will be slimer. For these circumstances, independent enterprises or employers who are not at all combined with each other appear to possess monopsonistic nature when the size of respective enterprises has reached a certain scale. Where such monopsony exists the workers are paid the wage less than the marginal net product, which fact A. C. Pigou and Joan Robinson call "exploitation of labor". Joan Robinson, based on the exploitation concept by Pigou, made minute analysis of the monopsonistic exploitation². Gordon F. Bloom also developed his theory of monopsonistic exploitation, using marginal net productivity or marginal revenue product as the basis to judge exploitation.³ Joan Robinson has stated in her later article that perfect competition hardly exists in the labor market and the image of perfect competition in labor market is even more unrealistic than that in the sales market for products, and she emphasizes that there in fact are many cases of monopsonistic exploitation.⁴

When an enterprise which employs so many workers as trade union can be organized holds in most cases a monopsonistic position in labor market and if the workers of such enterprise actually organize trade union to monopolize the labor supply, then there occurs a con-

² Joan Robinson, *The Economics of Imperfect Competition*, London, 1933, Chap. 26.

³ Gordon F. Bloom, A. Reconsideration of the Theory of Exploitation, in : *Quarterly Journal of Economics*, Vol. LV. 1940-1941. Reprinted in : *Readings in the Theory of Income Distribution*, 1950, pp. 245-277.

⁴ Joan Robinson, *An Essay on Marxian Economics*, London, 1949, pp. 75-76.

frontation between the two monopolistic powers, one of enterprise and the other of workers. Thus a bilateral monopoly comes into being.

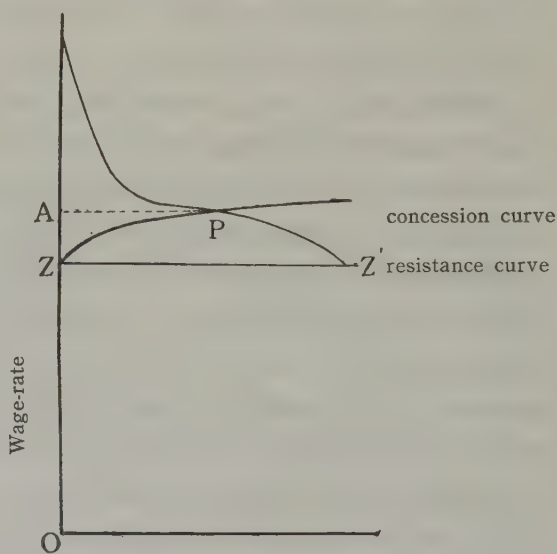
In the labor market, there is seldom a case where only supply of labor is monopolistic while demand is competitive, and therefore the process of wage rate determination under trade union should be studied with the theory of bilateral monopoly. This holds particularly true in the Japanese labor market. Because, craft union is, with historical background, very rare in Japan, and most of the unions belong either to intrafirm unions (unions of a firm-unit) or to the federation of these unions, viz, industry union.

While under bilateral monopoly the only and definite equilibrium price is theoretically impossible. Therefore, the monopoly theory cannot serve to the analysis of wage rate determined through the function of trade union. If the number of employment and the wage rate is imperfect substitutional for trade union, that is, if trade union is willing to accept a cut down of employment in exchange for the increase of their wage rate, or vice versa, there is still room for purely economic approach to this problem by assuming indifference curve between wage rate and employment. However, in most cases, such an approach is meaningless, because trade unions usually decline to take such an attitude except when it is a very special sort of craft union such as the union of Housekeepers. Therefore, such theoretical approach will contribute very little to the explanation of trade union activities. This is especially true in Japan, as mentioned before, where the majority of labor unions are either intrafirm unions or industry unions.

Now that the relations between employers and trade unions is understood as bilateral monopoly where monopoly theory is least workable, the wage rate cannot but be thought to be determined through the collective bargaining between the employer and the laborers and will be fixed at a point of equilibrium between the powers of both parties. In this connection a trial made by J. R. Hicks to seek for the wage rate at the point of equilibrium of powers of enduring strike or lockout between the employer and the labor is worth paying attention. When

the trade union demands wage increase, the employer has only two alternatives; viz. to accept their demand or to turn it down and endure the loss from business stoppage. The longer the expected period of strike, the greater loss is to be anticipated and consequently the employer will come to be ready for paying higher wage rate. Thus, it is possible to draw a curve which will represent a functional relation between strike period and the highest wage rate which the management is willing to pay. This curve is called employer's concession curve.

Likewise, on the part of trade union a curve representing functional relation between wage rate and strike period can be drawn, that is called trade union's resistance curve. In Fig. I, employer's concession curve and trade union's resistance curve come to cross at the point P, and the wage rate is represented by the height of OA. Even without having a dispute settled by strike, management and labor can draw these curves



Expected length of strike

Fig. I

and figure out the point P during the course of their negotiation.

According to Hicks, labor union's ability of enduring strike depends upon (1) the size of the union's accumulated fund (the amount of strike pay it can give) (2) savings of the members (which enable them to be content with a low rate of strike pay, or to hold out when strike pay has disappeared) (3) the attitude towards the strike of parties not directly concerned (the willingness of shopkeepers to give credit, the willingness of other unions or independent wellwishers to give loans or donations to the union), and this ability of the union, being combined with (4) union's sentimental consideration toward the dispute, will

finally determine the resistance curve.⁵

Evidently, the factors referred to by Hicks are all positive elements to determine the strength of bargaining power, but these factors *per se* do not necessarily belong to the category of monopoly. Therefore, to define the bargaining power as monopoly power is too confined a definition. Trade union's monopolistic power in labor supply is undoubtedly a significant factor to determine their bargaining power, but as stated above, also the employers hold monopsony power as to the labor demand. Therefore trade unions cannot fully display their monopolistic power in the actual labor market, because their power is more or less offset by the employer's counter power. Of course the strength of these two powers are seldom equal, so the difference between these two confronting powers may have a great influence on the determination of wage rate. But in case of bilateral monopoly it should be noted that the factors other than monopoly power will play dominant role in the determination of equilibrium point.

Thus the trade union's power to attain its objectives, i. e. the union's collective bargaining power in a broader sense should be weighed from various angles by taking into account a wide variety of factors which could not be covered by the monopoly power. First of all, as referred to by Hicks, the union's financial position, such as the amount of the union's accumulated funds, savings of union members, willingness of the third parties to extend loans and donations to the union should be taken into account. Secondly what is very important is the power of mass violence and based upon which, the power of mass coercion. As Neil W. Chamberlain has indicated "the literature of industrial relations is filled with recital of bloody conflict and even death as unionists who have sought grimly to make good their efforts to keep the price of disagreement high by restraining back-to-work movements or the employ of strike-breakers".⁶ Also in the post-war Japan there have been instances where labor movements used violence such as battering the executives or throwing stones at their president's house. This sort of

⁵ J. B. Hicks, *Theory of Wages*, New York, 1948, pp. 140-154.

⁶ Neil W. Chamberlain, *Collective Bargaining*, New York, 1951, p. 226.

violence, whether it is latent or apparent, serve to push the request of labor union. Thirdly, the favorable approach of the public to the unions should also be considered. If public opinion is favourable for the trade union, the union's bargaining power is evidently strengthened. It does not necessarily take concrete forms such as sympathy strike, sympathy boycott or donation from well-wishers etc. The press comments or even common talk will have psychological effect upon employers. That trade unions always publicize themselves to justify their request through the means of demonstration etc. is a positive proof that they are anxious to win the support of public opinion.

Fourthly, the current politics plays a vital role. Every worker has his right of voting for elections, that is exercised to the maximum benefit of the union under its control. This moves politics of course towards the direction aimed at by trade unions for the accomplishment of their objects. Bertrand Russell pointed out in his work that "trade unions, which immeasurably increase the bargaining power of wage-earner, can be suppressed if wage-earners have no share in political power; a series of legal decisions would have crippled them in England but for the fact that, from 1868 onward, urban working men had votes."⁷ The activities of trade unions are not confined to thus giving influence to politics through each vote of workers but, as is observed in recent Japan, they can as well move national politics whether directly or indirectly through their huge contributions to the socialistic political parties and through many other means. It is commonly known that the campaign of AFL had actually brought about Wagner Act in the United States.

Besides those enumerated above, there may exist many other things such as experience of trade unions and union leadership etc. which can be regarded as supporting bargaining power. Let us call these powers explained above that are not directly connected with monopoly as "Non-economic powers" in a broad sense. I mentioned "in a broad sense" because the non-economic powers meant here include such factors

⁷ Bertrand Russell: "Power, A New Social Analysis", London, 1948, p. 104.

as accumulated fund of trade unions, savings of members and donation from well-wishers referred to previously. It is true that these funds could be considered economic in that they are purchasing powers that enable the union members to buy commodities they need but their funds are not used to purchase commodities from the employer with whom they are in dispute but are to reinforce the union's power in bringing pressure upon the employer. Accordingly they can be considered as non-economic power in their relations to employers.

3. Factors beyond economic action

This kind of non-economic powers exist also on the part of employers as support to their bargaining power. The crossing point P of the concession curve and the resistance curve explored by Hicks can be broadly taken as indicating the equilibrium point of the bargaining powers of both parties including all such powers. As a matter of fact, these non-economic powers are more or less working in the actual competitive economy and yet they are done away with for the theoretical study.

As has been pointed out by Edward H. Chamberlin, the term "bargaining power" is ambiguous by nature. However, one of its primary meanings has reference to a indeterminate range of prices. Within the indeterminate range supply and demand meet at any price and competition does not therefore play a decisive role. According to typical analysis made by Austrian school, this range is clearly illustrated because of the discontinuous demand and supply schedules⁸ while, where the principle of "*natura non facit saltum*" works as in the case of A. Marshall, it is automatically compressed to one point. If there be a limit of such indeterminable range, it would be fixed by competition and the bargaining ceases to function beyond that limit. On the contrary, there exists bargaining but no competition within that limit. Any of the wages within the range is "competitive" and when the bargaining power of workers is stronger, the wage rate will nearer its

⁸ For example, refer to the case of trading horses by Böhm-Bawerk. ("*Positive Theorie des Kapitals*", Erster Band, III. Buch, II. Abschnitt, II.)

upper limit while it will come down to the lower limit when their power is weaker.⁹

Chamberlin says that the above theory can not be applied to the case of collective bargaining where bilateral monopoly rules. But I think, if it were a *pure* bilateral monopoly, a certain range would be divided by the curve which marks the limit of free preference action of the opposite party. Its lower limit is the supply curve of labor and the upper limit is the demand curve of labor or marginal net productivity curve. If the bargaining power of the employer is predominant, it is to choose the most profitable point on the supply curve in accordance with the principle of monopsony. On the other hand, when the trade union's power is overwhelmingly strong, it will choose the most advantageous point on the demand curve conforming to the general rule of supply monopoly. Thus, under the pure bilateral monopoly, even though non-economic powers work as a bargaining power, their maximum activity is marked off by the curve where the monopoly power of either side is displayed 100 per cent. So far as non-economic powers remain within this curve, there would exist nothing more than monopoly even when they are employed. In other words, economic action predominates non-economic one as far as it is pure bilateral monopoly. Now, will the activities of trade unions be ever confined within the boundary of such pure monopoly?

The monopolists can gain by controlling their supply (or demand) more profit or, broadly speaking, more revenue than by competition. Let us call this power which brings about more revenue "Monopoly power". The monopoly power in this sense is to stay within purely economic category. By "purely economic" is meant to be the synonym of "exchange-economic". In exchange or buying and selling, we show our conditions of exchange to the others and if they accept them on their free thinking, then we deal with them. In such occasion, if we force them to buy at a higher price against the will of the customer or force them to sell at an unreasonably cheap price, we are already

⁹ Edward H. Chamberlin: "The Monopoly Power of Labor", in: "The Impact of The Union", edited by David McCord Wright, New York, 1951, pp. 173-174.

trespassing the rule of exchange economy. It should be noted that compulsory economy (Zwangswirtschaft) still in existence in a form such as the tax collection by State and the type of economy other than exchange economy hold important meaning to the economy in a broad sense especially in its early stage but, nevertheless, all of the so called economics or theories of economy, whether they are those of competition or of monopoly, are based on the assumption of exchange economy. The monopoly power, however powerful it may be, never makes a forced buying. It may either restrict its supply (or demand) and observe where the price settles due to free reactions of the other party or watch how the quantity settles with a fixed price but all the same there is involved no compulsory element that trespasses free exchange. In pure monopoly, the monopolist acts in line with the demand (or supply) curve which marks the limit of free preference action of the demander (or supplier) opposed to him and never cross that line.

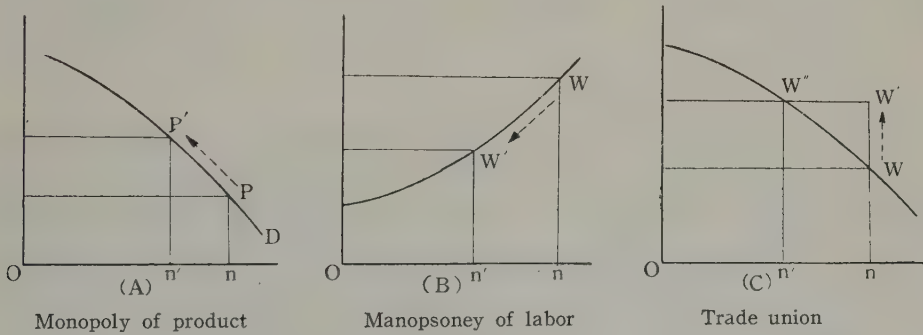


Fig. II

Now, let us give thought to the case of monopoly of product supply by Fig. II (A). When the monopolistic party pushes the price P up to P' , then the demand goes down from N to N' as a result of buyer's reaction. Contrarily, when the supply decreases from N down to N' , then P moves up to P' caused by competition among the buyers. After all, P is always held above the demand curve. A monopolist who has perfect knowledge about the demand curve can naturally determine the price and the supply at the same time. Even in that event, however, P is above the demand curve. Same principle is true with monopsony of

labor as the case of Fig. II (B), and the wage rate W can only go down to W' which is still above the supply curve. No employment at a wage below the supply curve can take place unless otherwise it is made under a forced labor system such as that during the war-time.

However, as seen in Fig. II (C), the control of labor supply by trade union is basically different from the above examples. Namely, trade unions try, as a rule, to raise wage rate without having the member of employed workers changed. So to speak, W does not go up along the demand curve but crossing the curve up above it. There has been no case where a trade union makes anyone of its members of equal ability leave his job for the sake of wage raise.

Occasionally, unions may accept the request for a personnel cut by the employer simultaneously with realization of wage rate raise, but actual execution of such acceptance has been made in a manner that voluntary retire is invited with extra high retire allowance in conformity with union's demand or that the dismissal is limited to only those whose labor efficiency is generally admitted to be particularly poor. After all, there never exists a case where the trade union has a worker of the average ability retire at their own will.

The decrease of supply by means of limiting new employment may certainly have nature common to monopolistic supply in general. However, this is no longer an important method used by trade union today. Also, strike may mean supply cut to zero, but it does not expect automatic wage increase through reaction on the part of the demand. The suspension of labor supply by strike is not of lasting nature but temporal, and it is used merely as a threatening measure. So with the lock-out by employers which is not a general method in monopsony.

In view of the above facts, one can not deny that the trade union has a character of claiming a wage rate over marginal net productivity. No employer wants to pay wage over marginal net productivity or he avoids to employ workers when the marginal net productivity could not catch up to their wage. Because it means a loss as much as $W - W'$ indicated in Fig. II (C).

Nevertheless, what enables the trade union to do so?

It is not the monopoly in terms of theoretical economy. As already mentioned monopoly could never go beyond the acts of exchange. Then it must be a *non-economic enforcing power*. In other words, non-economic factor holds here priority to purely economic factor, and the power of collective bargaining as thus defined must be social power (soziale Macht) in a sense that it subjugate the other party beyond the simple acts of exchange.

The action of trade union is either no longer simply monopolistic, or the collective bargaining power is not monopoly power in strict terms; though, of course, it is up to a person to term it monopolistic. For instance Edward H. Chamberlin maintains that it is not wrong to use the term "monopoly" in broader sense.¹⁰ But in that case, it has a different meaning from what has been dealt with by economics. Therefore, in our effort to make factual analysis, it will be far convenient not to simply define collective bargaining power as monopoly power which has traditionally been studied within the category of exchange economy.

4. Conclusion

From these characters of trade union one can draw a very important conclusion. That is, in monopoly the price could be increased optionally by a single party but there is a certain limit for the increase due to restriction by demand decrease (or supply), namely there works a automatic self-regulating function. It is because a monopolist in general acts in accordance with the principle of maximum profit that functions within the framework of exchange economy.

While, since the acts of trade union are not merely of monopoly as mentioned above but inherently have nature to go beyond monopoly, such economic regulating force can not work out for them. So, in principle, there is no limit in the claim for wage increase by trade union.

Against this, we know of an influential theory advocating the behavior of trade union. It maintains that the activities of trade union

¹⁰ Edward H. Chamberlin, op. cit., 186-187.

is to cope with the employer's monopsony of labor already in existence or with the exploitation meant by Joan Robinson. For instance, Maurice Dabb says "trade union action can be a powerful factor in counter-acting the influence that buyer's monopoly in the labor market can exert directly on money wages".¹¹ Such view has been introduced into article 1 of Wagner Act and has come to be a popular ground that justifies trade union activities.

It may be too much to say that such view is wrong. However, it is also improper to claim that wage increase is commonly demanded by trade union in accordance with such view.

Because, if the wage increase is claimed as a counter-offensive to the monopoly of demand, in some cases it must result in the increase of employment. In Fig. III, even though wage rate is fixed at W as the result of monopsony, let us presume that trade union has uplift the rate to W' . Then the employment must increase from N to N' . In other words, once wage rate has been raised, it would be advantageous for employer to make more employment and also the union has no specific reason to raise positive objection against in this.¹²

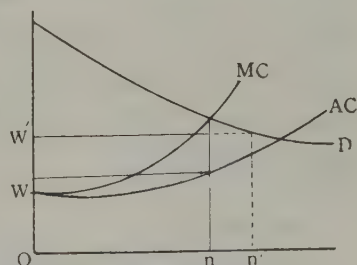


Fig. III

However, there is almost no instances of such simultaneous increase in employment together with raise of wage rate at least so far as Japan is concerned in recent years. Therefore we have to judge that there is comparatively few cases where trade union is exercising the collective bargaining power to push back monopolistic wage rate. (Of course the writer is not bold enough to say that marginal analysis of labor market as has been referred here is completely explored from every angle but will not touch this point now.) In almost all cases a trade union is raising the wage rate over marginal productivity or at least intends to do so.

¹¹ Maurice Dobb, *Wages*, London, 1941, p. 146.

¹² As is illustrated in the graph, this holds true with wage rate increase up to a certain extent.

There is wide and controversial problem as to what influence upon enterprise and national economy does exercise the increase of wage rate over marginal productivity. Speaking about the points;

- (1) in some cases as the results of wage increase, marginal productivity of labor will go upward and there works a tendency to restore the balance. It owes first of all to the improvement of labour efficiency. Secondly the wage increase gives, in a long run, a stimulant to invention or device so as to raise marginal productivity. However, one can expect so much neither the improvement of labor efficiency where the living standard of laborers is higher than a certain level, nor the invention or device to be achieved in a short run.
- (2) There is a tendency to restore the balance by reducing the employment and by substituting labor with capital goods. Trade union objects to dismissal but will not force employer to make new employment. So, the employer is able to reduce employment with a policy not to replace the worker retired due to the age limit or accident with new employment. Such trend will surely increase unemployment.
- (3) In case the wage increase is made in a wide range where the increase presents same competitive condition to most of enterprises, or in case of wage increase in monopolistic enterprise selling products or service with small elasticity of demand such as electric power or traffics, the increase of cost due to wage increase could easily be shifted to the price of service and products. Thus the balance could once be restored. However, insofar as the real wage is lowered, the trade union will plan the wage increase again, and there takes place vicious circle, thus inflation is to be accelerated.¹³
- (4) In case the wage increase is covered by curtailment of dividends

¹³ Keynes once said "a movement by employers to revise money-wage bargains downward will be much more strongly resisted than a gradual and automatic lowering of real wages as a result of rising prices" (General Theory, p. 264). However, in case a trade union is organized, the union workers are interested in the real wage rather than only money-wage as compared with those who are not organized. The importance of the fact that in the union office the fluctuation of real wage is carefully watched with constant use of money-wage and price index, should never be overlooked. This is most eloquently demonstrated by their demand made in the form of sliding scale or the market-basket method in Japan.

or executives' salary, there will be a change of distribution of net national income. By having net national income move to the class of larger marginal propensity to consume, the average propensity to consume of a country will rise and eventually there will be larger demand for consumption goods and consequently accelerated demand for capital goods. Thus here lies a possibility that marginal productivity curve will be raised and the balance will be recovered. This is an idea belonging to Keynesian school that supports wage increase. But in a country like Japan with little resources and capital, no one can expect too much from such economic mechanism.

- (5) If the balance cannot be restored through the processes mentioned above, the following results are to come. That is, in case the wage exceeds the marginal productivity but is yet below the average productivity, the enterprise does not go into a red though its profit might decrease. However, if the wage rate becomes higher than the average productivity, the enterprise, placing expectation on a future improvement, will manage the deficit with loans from outside, government subsidy, reduction of depreciation etc. This also harbours the element of inflation. After these observations, it may well be concluded that under the present-day circumstances of Japan the trade union movement toward raising wage without any consideration given to the improvement of labor efficiency will inevitably cause either increased unemployment or accelerate inflation.

A NOTE ON THE RICARDO EFFECT

SHINJI KAWAGUCHI

Since the well-known proposition of the Ricardo Effect was first introduced by Professor Hayek in his essay on industrial fluctuations,¹ there have been heated controversies² among economists centering around this proposition. Professor Hayek himself has played a positive role in these controversies by re-questioning and modifying this proposition in his new essay.³ The aim of the following note is to investigate the theoretical structure of this proposition and clarify its own significance in the field of economic theory by tracing the progress of these controversies.

I. PROBLEM OF THE RICARDO EFFECT

What is meant by the Ricardo Effect? According to Professor Hayek's own definitions⁴ we may understand that it implies that a fall in real wages due to a rise in product prices⁵ will tend to shift the period needed

¹ F. A. Hayek, "Profits, Interest and Investment" in the collection of essays published under the same title, 1939, pp. 3-71.

² For the main discussions of the Ricardo Effect, see T. Wilson "Capital Theory and the Trade Cycle", *Review of Economic Studies*, June 1940, pp. 169-180, reprinted in T. Wilson, *Fluctuations in Income and Employment*, 3rd ed., 1948, pp. 47-59; G. Haberler, *Prosperity and Depression*, 3rd ed., 1941, pp. 481-491; N. Kaldor, "Professor Hayek and the Concertina-Effect", *Economica*, November 1942, pp. 357-382; S. Tsiang, *The Variations of Real Wages and Profit Margins in relation to the Trade Cycle*, 1947, pp. 119-153; R. G. Hawtrey, *Capital and Employment*, 2nd ed., 1952, pp. 248-252. We also find some references to this proposition in the following literatures: H. M. Somers, *Public Finance and National Income*, 1949, pp. 93-101; A. H. Hansen, *Business Cycles and National Income*, 1951, pp. 391-393; D. Hamberg, *Business Cycle*, 1951, pp. 221-227; L. M. Lachman, "A Reconsideration of the Austrian Theory of Industrial Fluctuations", *Economica*, May 1940, pp. 179-196; F. Lütolf, *Die Theorie der monetären Kreislaufshären*, 1952, S. 127-129.

³ F. A. Hayek, "The Ricardo Effect", *Economica*, May 1942, pp. 127-152, reprinted in F. A. Hayek, *Individualism and Economic Order*, 1948, pp. 220-254. Also see F. A. Hayek, "A Comment", *Economica*, November 1942, pp. 383-385; idem, *The Pure Theory of Capital*, 1941, pp. 369-396.

⁴ F. A. Hayek, *Profits, Interest and Investment*, pp. 9-10; idem, *Economica*, May 1942, p. 129.

⁵ By the prices of products Professor Hayek means the prices of final products or consumers' goods and he also assumes that their rises are "due to an increase of demand caused by a growth of incomes earned from producing investment goods". cf. F. A. Hayek, *Economica*, May 1942, p. 130.

in the production method adopted in any firm. It means, in the terms of modern capital theory, that the degree of capital intensity or the shortening of capital will be brought about by a fall in real wages. The causal relationship between the fall in real wages and the shortening of production method may be explained by the following two proposition.

(1) The extent of rising profitability brought about by a general fall in real wages owing to a rise in product prices is larger in the case of shorter period production than in the longer one.

(2) Such a change in profitability tends to shift the production method from that of longer period to that of shorter one.

An entrepreneur's increased profits owing to a rise in prices of his own products may be realized in a circulating process by an increase in the output of the products. As regrrd to the methods of increasing output, Dr. Hawtrey, assuming the method of production unchanged, asserts two methods, i. e. the 'widening' and the 'deepening' of capital.⁶ Professor Hayek, however, does not agree with Dr. Hawtrey on his line of reasoning. As stated above, Professor Hayek asserts the 'shortening' of capital which means a quite opposite method to Dr. Hawtrey's; both the 'widening' and 'deeping' of capital cause an increase of the amount of capital goods or real investment, the 'shortening' of capital bringing about an opposite result. On what ground does the Hayekian entrepreneur stick to this method instead of adopting the Hawtreyian method? This is one of the most fundamental problems of the Ricardo Effect.

II. TWO ASSUMPTIONS OF THE HAYEKIAN ENTREPRENEUR

In order to give a definite answer to this question, it is necessary to admit two assumptions about the Hayekian entrepreneur. One is the use of the concept of the rate of profit as a concrete criteria of the profitability of available production methods, and the other is the existence of a limitation for the supply of funds available to the entrepreneur.

The determinant of the production method which should be adopted

⁶ R. G. Hawtrey, *Capital and Employment*, 2nd ed., pp. 31-33. cf. F. A. Hayek, *The Pure Theory of Capital*, p. 286.

by any entrepreneur is the relative profitability of various methods of production. For the operation of the Ricardo Effect, therefore, the profitability of the shortening of capital, in other words, the rationality of the above-mentioned first process should be first demonstrated. Professor Hayek demonstrates this by mentioning two kinds of profit rates, i.e. the internal rate of return and the profit margins⁷. The internal rate of return is the per annum net percentage of the return on the capital invested and the profit margins are the percentage of the return on the capital at each turnover of capital. When the internal rate of return (I) is constant, the profit margins (M) vary inversely with the rate of turnover of capital (T),⁸ i.e. $M = \frac{I}{T}$. The internal rate of return is shown by the product of the profit margins and the rate of turnover of capital, i.e. $I = MT$.

Let us suppose by way of example that there are three types of methods with the rates of turnover of 6, 1 and 1/10 respectively and with the internal rate of return of 6% equally, the profit margins of each method are 10%, 6% and 60% respectively ($M = \frac{I}{T}$). 5% rise in product prices, in case of constant costs,⁹ will increase the profit margins of each method by 5% equally. Then the profit margins of three methods amount to 6%, 11% and 65% respectively. These increased profit margins correspond to the internal rates of return of 36%, 11% and 6.5% in each method ($I = TM$). Thus we can see from this illustration that the degree of rising profitability is relatively larger in the method which has more frequent rate of turnover.¹⁰

⁷ F. A. Hayek, *Economica*, May 1942, pp. 130-134.

⁸ Professor Hayek uses this term as a criteria by which the relative length of production method should be measured. cf. F. A. Hayek, *ibid*, pp. 131-132.

⁹ Professor Hayek explicitly assumes that the money rate of interest, money wages and other constituents of the costs of production are constant and entrepreneurs expect product prices to remain at least for some considerable time at a new high level. cf. F. A. Hayek, *Economica*, May 1942, pp. 133, 130. Moreover, we have to indicate that he implicitly assumes the unchanging production technique, full utilization of existing equipments and constant relative prices of capital and labour.

¹⁰ The variations of profitability may be seen both between respective capitals of each firm and between respective parts of capital of a firm, and we can not overlook the fact that the variation of profitability in the latter case has more important relation to the operation of the Ricardo Effect.

We should not overlook the fact that the use of the concept of the rate of profit has a strategic significance in Professor Hayek's reasoning described above. Then, for what reason does Professor Hayek adopt the concept of the rate of profit instead of others? We can see that this is due to the tradition of the Austrian School. We have, however, to observe that the logical basis of Professor Hayek's adoption of the rate of profit is an existence of the limited supply of funds available to entrepreneurs. This is nothing but the second assumption which we have already mentioned about the Hayekian entrepreneur.

The doctrine that the amount of investment is settled just where the marginal efficiency of capital or the natural rate of interest intersects with the money rate of interest now belongs to one of the well-known knowledges of modern economic theory. This doctrine, however, does not necessarily imply that in practice investment always could be pushed to that point. Because, in order to push investment to that point actually, it is indispensable for any entrepreneur to obtain sufficient available funds.

But the actual money market is the seller's market dominated by imperfect competition. In this market borrowers cannot obtain all funds that they desire to borrow at a given market rate of interest. The amount of funds obtainable is limited by the value of securities which can be offered by borrowers.¹¹ There is always an unsatisfied demand for available funds, in other words, there lies 'unsatisfied fringe of borrowers', as Keynes calls.¹² Except a few big firms which always have close connections with what is called 'finance capital', almost all firms, medium and small, are obliged to confront such limits of available funds. What is the first consideration in these medium and small firms in the formation of their investment policy is not the maximum profit on a given rate of output or the cheapest cost in production of a given amount of output, but the maximum profit on a given capital or the maximum rate of profit.¹³

¹¹ cf. F. A. Hayek, *Economica*, May 1942, pp. 139-140.

¹² J. M. Keynes, *A Treatise on Money*, 1931, vol. 1, pp. 212, vol. 2, pp. 364-367.

¹³ For a more detailed discussion of this point, see T. Scitovsky, *Welfare and Competition*, 1951, pp. 203-214.

It is not accidental that Dr. Kaldor admits that the Ricardo Effect is only valid for the entrepreneurs unable to attain any additional credit, or, in other words, for the so called 'Wicksell-firm', and denies its validity for the entrepreneurs capable of it. Because the relevant consideration of the latter type of entrepreneurs is the maximum profit on a given rate of output, i.e. the maximum total amount of net profit calculated on the basis of total revenues minus total costs. And if this concept of net profit is approved, we may also admit, following the line of reasoning by Dr. Kaldor and Dr. Wilson, that the relative profitability will not be altered by any fall in real wages and accordingly that there is no decrease in the degree of capital intensity.¹⁴

III. SIGNIFICANCE OF THE CHANGES IN PRODUCTION METHOD

In the preceding chapter we explained the first proposition of the Ricardo Effect by admitting two assumptions about the Hayekian entrepreneur. Our next step is to explain the second proposition which contains the causal relationship between changes in relative profitability and production method. Now, the question is what is meant by the 'changes in production method'. This reminds us of the fact that Professor Haberler once criticized Professor Hayek's overestimation of the possibility of substituting labour for capital in a short period.¹⁵ If the 'changes in production method' mean the changes in the proportion of the existing stock of fixed capital to circulating capital, i.e. what Marx called 'organic composition of capital', then we may as well doubt its possibility in accord with Professor Haberler. Because the organic composition of capital itself may be changed only in the course of a long term. Then is this doubt really well founded? The answer is in the negative. For the substance of 'changes in production method' meant by Professor Hayek is nothing but the changes in 'the rates at which firms will spend their current outlay in renewing (or adding to) the two kinds of capital'

¹⁴ N. Kaldor, *Economica*, November 1942, pp. 373-379; *Economica*, February 1939, pp. 41-52; T. Wilson, *op. cit.*, pp. 51-55.

¹⁵ G. Haberler, *op. cit.*, pp. 488-489.

¹⁶ cf. F. A. Hayek, *Economica*, May 1942, pp. 135-138.

This idea of 'changes in production method' is very important for the true realization of the *fundamental character and significance* of the Ricardo Effect. We may now realize it as an entrepreneur's principle in distribution of available funds. Where changes should occur in the profitability of productions of different methods, they will be followed by the changes in the relative ratio of expenditure between machines (fixed capital) and wages (working capital). Consequently, the entrepreneurs' available funds will be distributed more on the working capital which has a larger rate of turnover and less on the fixed capital which has a smaller rate of turnover. In other words, an increase of expenditure on the working capital will be effected at the sacrifice of the expenditure on the fixed capital.

The substance of the Ricardo Effect is nothing but the intensified utilization of the existing equipments by the increase of an expenditure on working capital.¹⁷ We may easily admit that in practice such a method would be often adopted by the entrepreneurs who have limited funds available and intend to increase the output quickly in the short period to attain an increase of their expected profits. Here we must keep it well in our minds that the proposition of the Ricardo Effect is not a mere abstract one but a realistic one which often directs the investment policy of any entrepreneur.

IV. IMPORTANCE OF THE PROFIT MARGINS

An assertion that an increase of profit margins due to a rise in the prices of products makes an entrepreneur adopt the above-mentioned method is not peculiar only to the Ricardo Effect. We find that such an assertion was held by Marshall as 'the immediate effect of the expectation of a high price'¹⁸. But Marshall concerned it to explain the

¹⁷ Dr. Kaldor has classified capital intensity into the 'actual' and the 'normal' and declared that the 'actual' intensity will be determined entirely by the level of real wages. cf. N. Kaldor, *Economica*, February 1939, pp. 43-44, 52. Which kind of capital intensity does Professor Hayek's Ricardo Effect concern? Professor Haberler once pointed out that Professor Hayek was interested in the normal capital intensity. cf. G. Haberler, *op. cit.*, p. 438 note 2. But when we come to know the real contents of the Ricardo Effect, we may realize that Professor Hayek is mainly interested in the actual capital intensity which means the changes in the amount of labour employed in connection with a given equipment.

¹⁸ A. Marshall, *Principles of Economics*, 8th ed., 1920, p. 374.

formation of short-period supply price, and did not take into consideration the process itself through which such production method is adopted. Professor Hayek, however, concerns the process itself. This process is explained, as already mentioned, by using the causal relationship between a fall in real wages and an increase in profit margins. In this process, we must emphasize the strategic significance of an increase in profit margins. A fall in real wages is nothing but one of the main causes of this increase in profit margins.

Professor Hayek explains this process with the assumption that costs are constant. This assumption will make it possible to describe simply the effect of the rise in product prices on the profit margins. But this is not always essential for the operation of the Ricardo Effect. The necessary condition is that the increasing effect of profit margins induced from the rising product prices must not be offset by the rise in various costs. We must admit the existence of this condition in the case of the money rate of interest among the various cost items. It is because that the money rate of interest is more stable than is assumed in the field of pure theory. Moreover, we may also admit this in the money wages if the rise in money wages continuously raises the product price through an increased demand for consumers' goods. But as to the prices of raw materials constituting the main part of production costs, it is difficult always to admit it, because we must expect the price of raw materials to rise. In some cases, an increase of profit margins will be easily offset by a rise in prices of raw materials.

Now the real wages are not only one cost item that is reduced by a rise in product prices. So far as the rising rate of prices of raw materials does not exceed the rising rate of product prices, the real costs of raw materials, i.e. the ratio of money cost of raw materials to product prices will also relatively fall. This fall in the real cost of raw materials is also one factor of an increase of profit margins. From the view point of an increase of profit margins, therefore, a fall in the real cost of raw materials is not different from a fall in real wages, in other words, there is no peculiar reason to talk only about a fall in real wages. Thus we may realize that it is better to define the concept of real wages as

'a convenient shorthand expression for the relation between the prices of the firm products and factors', as it was defined by Dr. Kaldor,¹⁹ or to use explicitly the concept of profit margins or cost-prices relationship instead of that of real wages. To use a more adequate definition or term such as this is also necessary to avoid the unnecessary confusions about the concept of real wages.²⁰ The shortening of capital or production method which is indicated by the Ricardo Effect is the method which should be necessarily adopted by the entrepreneurs intending to increase their output quickly with a given available funds to attain an increase of profit margins due to a rise in product prices. It is no matter whether this increase of profit margins is due to a fall in real wages or to a fall in real costs of raw materials.

V. RICARDO AND MARX

Needless to say, the proposition of the Ricardo Effect is the modern reformation of the Ricardo's classical doctrine concerning the changes in wages and values.²¹ Professor Hayek, following in the footsteps of Ricardo, talks about the effects of the variation of wages upon production methods. But we should not overlook the fact that the doctrines are quite different from one another in theoretical structure.

It is common to both doctrines that the cause of the changes in production methods is based on the changes in the rate of profits, but the process from which this changes in the rate of profit arise is not

¹⁹ N. Kaldor, *Economica*, November 1939, p. 48 note 2.

²⁰ Professor Hayek's concept of the real wages is different from that commonly used. 'Real wages' in general use mean the amount of wage-goods which can be purchased with money wages earned by labours. Professor Hayek's real wage, however, means the so-called 'product wages' which are determined by the relation of the level of money wages to product prices. In the case of a fixed money wages, a rise in product prices would naturally bring about a fall in these real wages. Moreover, under the condition of cost of production being unchanged, the profit margins obviously increase in proportion as the product prices advance. Professors Haberler, Hansen and Somers make their criticism of the empirical basis of a fall in real wages standing on the ground of the well-known investigation of Professors Dunlop and Tarshis who doubt the necessity of a fall in real wages during the later stages of a boom. We, however, easily realize that these doubts do not keep to the point. It is because Professor Hayek's real wage is different from real wages in common use.

²¹ For the Ricardo's original doctrine, see D. Ricardo, *Principles of Political Economy and Taxation*, Gonner's edition, pp. 33, 386.

the same. In Ricardo, the first impact to bring about the changes in the rate of profit is a rise or fall in wages, while it is through the changes in relative prices of wages to machines that makes the use of machinery (or labour) more profitable by a rise (or fall) in wages. In other words, it is based on the unchanging price of machinery independent of the changes in wages, i.e. Dr. Hawtrey's cost-effect.²³ Moreover, such changes in relative prices may be admitted when there exist the changes in the rate of profit in the machine-making industry and the equalization of the rate of profit in this industry²⁴. According to Professor Hayek, however, it is assumed that there are constant money wages and relative prices of wages to machines and an increase of profit margins is brought about directly from a fall in real wages due to a rise in product prices. The reason why the internal rate of return which is the per annum rate of profit margins becomes larger in the shorter method of production in which more labour is required is due to nothing but the fact that the rate of turnover of capital becomes the larger in this method.

Thus we may understand that there is a basic difference between the reasonings of Professor Hayek and Ricardo.²⁵ However, such an existence of difference does not necessarily imply that the structure of Professor Hayek's reasoning positively occupies a unique standing in the field of economic theory. For in Marx's *Das Kapital* we shall find the

²² Professor Hayek, in his *Profits, Interest and Investment* (pp. 39, 69), seems to assert also the validity of the Ricardo Effect in case of a *rise* in wages. The same idea will be found also in *The Pure Theory of Capital* (pp. 378-379, note 1). But in 'The Ricardo Effect' he makes doubt of this validity and confines it to the case of a *fall* in wages. This reversion is thought to be correct, because, from Professor Hayek's line of reasoning, a rise in real wages is due to a fall in products prices, and 'the immediate effect of the expectation of a low price', as Marshall already indicated, is 'to throw many appliances for production out of work and slacken the work of others'.

²³ R. G. Hawtrey, *op. cit.*, p. 249.

²⁴ For this point, see D. Ricardo, *op. cit.*, pp. 33-34 and N. Kaldor, *Economica*, November 1942, pp. 364-367.

²⁵ We of course do honour to the Professor Hayek's profound comprehension of the classical economics. But we regret to say that his intensions to seek the classical exposition of his own original ideas in the classical economists' writings sometimes seem rather overstrained. We can find some similarities between his treatment of the Ricardo's doctrine and that of the Mill's famous 'fourth proposition respecting capital' (demand for commodities is not demand for labour). He, in this proposition, seeks after the classical exposition of his original idea which asserts the relation in inverse proportion between demand for consumers' goods and

similar but more comprehensive explanations to the various possible relations indicated by the formula $I=TM$ on which Professor Hayek's reasoning is fundamentally based.²⁶

demand for labour. cf. F. A. Hayek, *The Pure Theory of Capital*, pp. 433-439; idem, *Profits, Interest and Investment*, p. 33. When we read the Mill's *Principles* (Ashley's edition, pp. 79-88), however, we can easily realize that the substance of Professor Hayek's idea is quite independent of Mill's proposition and his treatment of this proposition is too superficial. For the discussion of this point, see S. Kawaguchi, "On J. S. Mill's Fourth Proposition respecting Capital", *Keizaigaku* (The Economic Review of Osaka University), November 1951, pp. 77-99.

²⁶ K. Marx, *Das Kapital*, Bd. II, Kap. 16, Bd. III, Kap. 4.

A NOTE ON DISCRETE VARIABLE SERVO THEORY IN INVENTORY CONTROL

TAMOTSU YOKOYAMA

The application of servomechanism theory to the theory of production control was first developed by Prof. Herbert A. Simon¹ and Dr. Herbert J. Vassian developed the discrete variable servo theory in inventory control². Dr. Vassian considered the simplest inventory control system which is demonstrated by the following two equations:

$$(1) \quad I_k = I_{k-1} + \theta_{k-(T+1)} - C_k$$

$$(2) \quad \theta_k = \sum_{j=0}^k G_j C_{k-j} + \sum_{j=0}^k H_j I_{k-j}$$

where

I_k = inventory at the end of the k^{th} period,

θ_k = reorder quantity,

C_k = cumulative customer orders received during the k^{th} period,

T = lead time.

G_j, H_j = linear operator.

The power series transforms of these equations become

$$(1') \quad I(z)(1-z) = z^{T+1}\theta(z) - C(z)$$

$$(2') \quad \theta(z) = G(z)C(z) + H(z)I(z).$$

Let $C^*(z)$ be the transform of forecast customer orders. Then it can be shown that (2') becomes

$$(2'') \quad \theta(z) = z^{-(T+1)}C^*(z) + H(z)I(z).$$

Eliminating $\theta(z)$ from (1') and (2''), we have

$$(3) \quad I(z) = \frac{C^*(z) - C(z)}{1 - z - z^{T+1}H(z)}.$$

To obtain a minimum transient response, Dr. Vassian chose

$$(4) \quad H(z) = -\frac{(1-z)}{(1-z^{T+1})}$$

because this makes the right hand side of the equation (3) possess all poles at infinity. Furthermore he proved that of all linear decision rule the reorder rule which is given by this $H(z)$ provides the minimum inventory variance to any sequence of forecast errors of future customer orders.

In this note we shall show that of all linear decision rule $H(z)$ can be determined uniquely as the result of requirements that (1) the desired reorder rule must have minimum transient response and (2) to any sequence of forecast errors of future customer orders the inventory variance must be minimum.

First we shall make the reorder rule have minimum transient response. The condition for this is that the right hand side of equation (3) has all poles at infinity.

As H_j 's are linear operator, the transform $H(z)$ of H_j 's must be rational function of z . Thus we put

$$(5) \quad H(z) = \frac{b_0 + b_1 z + \dots + b_n z^n}{a_0 + a_1 z + \dots + a_m z^m}.$$

Substituting this into the right hand side of equation (3), we have

$$\begin{aligned} & \frac{C^*(z) - C(z)}{1 - z - z^{T+1} \frac{b_0 + b_1 z + \dots + b_n z^n}{a_0 + a_1 z + \dots + a_m z^m}} \\ &= \frac{[C^*(z) - C(z)](a_0 + a_1 z + \dots + a_m z^m)}{(a_0 + a_1 z + \dots + a_m z^m) - z(a_0 + a_1 z + \dots + a_m z^m) - z^{T+1}(b_0 + b_1 z + \dots + b_n z^n)}. \end{aligned}$$

In order to make the above function possess all poles at infinity we must impose following conditions:

$$T+n = m,$$

$$a_0 = a_1 = \dots = a_T; \quad a_{T+1} = a_0 + b_0, \quad \dots, \quad a_{T+n} = a_0 + b_0 + \dots + b_{n-1} = -b_n,$$

$$a_0 \neq 0.$$

Substituting these relations we have

$$(5') \quad H(z) = \frac{b_0 + b_1 z + \dots + b_{n-1} z^{n-1} - (a_0 + b_0 + \dots + b_{n-1}) z^n}{a_0(1 + z + \dots + z^T) + (a_0 + b_0) z^{T+1} + \dots + (a_0 + b_0 + \dots + b_{n-1}) z^{T+n}}.$$

Using this we can easily derive the reorder rule which provides minimum transient response.

Next we shall make this reorder rule provide minimum inventory variance to any sequence of forecast errors of future customer orders.

We define the forecast errors of future customer orders by

$$E_k = C_k^* - C_k.$$

Then the transform of this becomes

$$E(z) = C^*(z) - C(z).$$

Using this and equation (5) we have

$$(6) \quad I(z) = E(z) \frac{a_0(1+z+\dots+z^T) + (a_0+b_0)z^{T+1} + \dots + (a_0+b_0+\dots+b_{n-1})z^{T+n}}{a_0}$$

Taking the inverse transform of this we have

$$(7) \quad I_k = E_k + E_{k-1} + \dots + E_{k-T} + \sum_{j=T+1}^{T+n} F_j E_{k-j}$$

where

$$F_j = \frac{a_0 + b_0 + b_1 + \dots + b_{j-(T+1)}}{a_0}, \quad (j = T+1, \dots, T+n).$$

Now we assume that E_k 's are independent to each other. Then the necessary and sufficient condition for minimum inventory variance to any sequence of forecast errors of future customer orders is that all F_j 's vanish. Thus we have

$$F_j = 0, \quad (j = T+1, \dots, T+n), \\ a_0 \neq 0$$

viz.

$$a_0 \neq 0, \\ a_0 + b_0 + b_1 + \dots + b_{j-(T+1)} = 0, \quad (j = T+1, \dots, T+n).$$

As previously mentioned the conditions for minimum transient response are:

$$T+n = m, \\ a_0 = a_1 = \dots = a_T; a_{T+1} = a_0 + b_0, \dots, a_{T+n} = a_0 + b_0 + b_1 + \dots + b_{n-1} = -b_n, \\ a_0 \neq 0.$$

Combining these conditions we have

$$\begin{aligned} a_0 &= a_1 = \dots = a_T \neq 0, \quad a_{T+1} = a_{T+2} = \dots = a_{T+n} = 0, \\ T+n &= m, \\ b_0 &= -a_0, \quad b_1 = b_2 = \dots = b_{n-1} = b_n = 0. \end{aligned}$$

Substituting these relations into (3) we get

$$H(z) = \frac{b_0 + b_1 z + \dots + b_n z^n}{a_0 + a_1 z + \dots + a_m z^m} = \frac{-a_0}{a_0(1 + z + \dots + z^T)} = -\frac{1-z}{1-z^{T+1}}.$$

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